

**THE ROLE OF ATTACHMENT TO PARENTS IN THE ETIOLOGY
OF SUBSTANCE USE DISORDER**

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University of Pittsburgh, 2015

Substance Use Disorder (SUD) is a major public health problem costing over 500 billion dollars annually. An estimated 24.6 million Americans over age 12 were illicit drug users. 21.5 million are classified with dependence or abuse of alcohol and/or illicit drugs. Despite research efforts, the understanding of SUD etiology is still limited. Much research shows that SUD runs in families due to genetic and environmental contributions. Low attachment to parents, consequent to the chronic effects of parental SUD, may underlie the association between parents' and offspring's SUD. To date, limited research has been conducted to determine whether parent-child attachment bears on the relationship between SUD in parents and SUD risk in offspring. The aim of the current study was to determine the role of attachment to parents in the mechanism by which SUD in parents contributes to SUD risk in children. It was hypothesized that (1) parents' substance use severity, among other SUD related variables, most consistently predicted substance involvement (substance use and SUD severity) in sons; (2) attachment to parents was associated with sons' substance involvement, after accounting for parental substance use severity; (3) attachment to parents mediated and moderated the association between parents' and sons' substance use severity. Linear regression analysis determined that parental substance use severity was the most consistent predictor of sons' substance involvement. Structural equation modeling showed that parental substance use severity mediated the association between parental SUD severity and sons' substance use severity. After controlling for parental substance use

severity and supervision, attachment to parents explained additional variance in sons' substance involvement, and was associated with the onset rates of cannabis initiation, regular use, and problems with use. Structural equation modeling showed that attachment to fathers' mediated the relationship between fathers' and sons' substance use severity, which leads to sons' SUD. No significant moderation effects were found for attachment to parents. Attachment to parents also predicted illicit substance use at age 16. This study establishes that parent-child attachment is an integral factor in SUD etiology. Attachment based assessment and prevention tools may potentially improve clinical outcomes.

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PREFACE

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ABBREVIATIONS

CAPIB	Child Assessment of Parental Involvement and Behavior
CEDAR	Center for Education and Drug Abuse Research
CFI	Comparative Fit Index
CI	Confidence Interval
DF	Degrees of Freedom
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorders 3rd Edition Revised
IPPA	Inventory of Parent and Peer Attachment
K-SADS	Kiddie-Schedule for Affective Disorders and Schizophrenia
PIML	People In My Life
RMSEA	Root-Mean-Square Error
SCID	Structured Clinical Interview for Diagnosis
SD	Standard Deviation
SUD	Substance Use Disorder
SUD+/-	Substance Use Disorder Affected/Nonaffected
SUDSI	Substance Use Disorder Severity Index
SUSI	Substance Use Severity Index
TLI	Tucker-Lewis Index
YAPS	Youth Attachment to Parents Scale

FORMULAS

Mediation effect (Sobel, 1982):

$$z = \frac{b_1 b_2}{\sqrt{b_2^2 \sigma_{b_1}^2 + b_1^2 \sigma_{b_2}^2}}$$

Factor difference ratio (Hattie, 1985):

$$\text{ratio} = [(\text{eigenvalue 1}) - (\text{eigenvalue 2}) / (\text{eigenvalue 2}) - (\text{eigenvalue 3})]$$

1.0 CHAPTER 1: INTRODUCTION

1.1 ASSOCIATION BETWEEN SUD IN PARENTS AND SUD IN CHILDREN

Results of the 2013 *National Survey on Drug Use and Health* indicate that 8.2% of the U.S. population (21.6 million) satisfies criteria for substance dependence or abuse during the past 12 months (Substance Abuse and Mental Health Services Administration, 2013). Within the 12-17 years old age range, 5.2% and 2.8% of the U.S. population qualify respectively for diagnosis of dependence or abuse consequent to using an illicit substance or alcohol. Consumption prevalence of the most commonly used illicit drugs is presented in Table 1.1. The prevalence of illicit drug use in 2013 (9.4%) changed little since 2012 (9.2%) and 2010 (8.9%), and increased from 2002 to 2009. Hence, research that can improve prevention is a high priority, especially considering that SUD exacts a cost of 500 billion dollars annually to the U.S. economy (NIDA, 2008). Effective prevention is, however, contingent on understanding the risk factors that promote SUD development.

Table 1.1: Current Illicit Substance Use: 2013 National Survey on Drug Use and Health in Americans 12 Years of Age and Older

Substance Use (Past Month)	Number of Users (Million)	% of Population
Marijuana	19.8	7.5
Cocaine	1.5	0.6
Heroin	0.29	0.1
Hallucinogens	1.3	0.5
Methamphetamine	0.6	0.2
Prescription Drug - Without Medical Supervision	6.5	2.5
Pain Relievers	4.5	1.7
Tranquilizers	1.7	0.6
Stimulants	1.4	0.5

Adapted from Substance Abuse and Mental Health Services Administration, 2014

Towards this goal of preventing SUD, it is noteworthy that SUD in parents is the strongest predictor of SUD in their children. Biological children of SUD parents have 4-7 fold increased risk to also develop SUD (Vanyukov & Tarter, 2000). Risk for SUD is also increased in these children even when raised by adoptive non-SUD parents (Bohman, Sigvardsson, & Cloninger, 1981; Cloninger, Bohman, & Sigvardsson, 1981; Cadoret, Troughton, O'Gorman, & Heywood, 1986). Children reared by adoptive and step-parents who were alcoholics also have increased risk for alcohol abuse, illicit drug use, and drug dependence (Newlin, Miles, van den Bree, Gupman, & Pickens, 2000). Thus the relationship between parents' SUD and children's SUD risk has both genetic and non-genetic influences (see Vanyukov & Tarter, 2000 for review). The non-genetic influence may result from parents' modeling substance use behavior (King et al., 2009; Biederman, Faraone, Monuteaux, & Feighner, 2000). In sum, SUD runs in families consequent to genetic and parental environment influences (Cadoret et al., 1986; Pickens et al., 1991; Tsuang et al., 1996; van den Bree, Johnson, Neale, & Pickens, 1998).

1.2 PARENTING BEHAVIOR AND SUD IN CHILDREN

Whereas SUD in parents amplifies risk for substance use and SUD in their children, it accounts for only a portion of risk variance. Inept parenting and hostile family environment, independently of substance use/SUD in parents, impact children's risk for substance use and SUD (Chassin & Handley, 2006; Steinberg, Fletcher, & Darling, 1994). One relatively unexplored aspect of dysfunctional parenting is the quality of parent-child attachment (Ainsworth, 1985ab). This project examines the role of parent-child bonding on the relationship between parental substance use/SUD and risk for SUD in their children.

1.2.1 Parenting Behaviors and Children's SUD Risk

Dysfunctional and ineffective parenting consistently predicts children's substance use and SUD. Children receiving suboptimal monitoring and supervision from parents perceive that their activities are less regulated and are more likely to exhibit risky behaviors. Low supervision and monitoring by parents predict alcohol and drug use in adolescents (Dishion, Capaldi, Spracklen, & Li, 1995; Forehand, Miller, Dutra, & Chance, 1997). Parental supervision of adolescent offspring largely involves communication pertaining to their children's whereabouts, peers, schedule and contact information. Low parental supervision involving these matters increases risk for alcohol use disorder in their adolescent children (Clark, Thatcher, & Maisto, 2004). Furthermore, adolescents receiving low supervision exhibit more frequent drinking occasions, consume larger quantities of alcohol and are more likely to have alcohol use disorder compared to adolescents who receive optimal parental supervision (Clark, Thatcher, & Maisto, 2005). Poor monitoring by parents in conjunction with inconsistent discipline also promote delinquency and substance use (Clark & Winters, 2002; Barnes, Reifman, Farrell, & Dintcheff, 2000; Gorman-Smith, Tolan, Loeber, & Henry, 1998; Peterson, Hawkins, Abbott, & Catalano, 1994).

Maltreatment of children by parents, consisting of neglect or abuse, is among the strongest predictors of substance use and SUD in children (Dunn et al., 2002). Child maltreatment also amplifies risk for social maladjustment and other psychiatric disorders (Cicchetti & Toth, 1995; Crouch & Milner, 1993; Gaudin, 1999; National Research Council, 1993). Indeed, the high rate of childhood maltreatment among youths who develop substance abuse and SUD suggests that it is a particularly salient risk factor (Schaefer, Sobieragi, Hollyfield, 1988; Toray, Coughlin, Vuchinich, & Patricelli, 1991). Adults with SUD, for example, who experienced neglect, begin substance use at an earlier age (Icick et al., 2013).

Parental neglect of and insensitivity to their children's distress also facilitates development of substance abuse, along with other psychiatric problems in youths whose parents have a history of substance abuse (Bays, 1990, Famularo, Kinscherff, & Fenton, 1992; West & Prinz, 1987; Chasnoff & Lowder, 1999; Hawkins, Catalano, & Miller, 1992). Emotional distance in conjunction with low parental involvement, although a less severe variant of neglect, is also associated with higher risk of SUD (Kirisci, Dunn, Mezzich, & Tarter, 2001; Tarter, Kirisci, Habeych, Reynolds, & Vanyukov, 2004, Velleman, Templeton, & Copello, 2005). Low parental involvement has similarly been frequently demonstrated to be associated with behavioral problems in children presaging substance abuse (Dishion & Loeber, 1985; Dishion and McMahon, 1998; Dishion, Kavanagh, Schneiger, Nelson, & Kauffman, 2002). In aggregate, the findings indicate that neglectful and emotionally distant/uninvolved parenting magnifies risk for substance use and SUD in children.

Although there are fewer reported cases of physical and sexual abuse than neglect (Barth, 1998; Lewit, 1994), it is well established that abuse experienced during childhood has profound deleterious effects on mental health as well as predicts problems related to substance use (Gilbert et al., 2009, Clark, Thatcher, & Martin, 2010). A history of physical and sexual abuse and witnessing violence in middle school and high school students are associated with alcohol initiation at a young age (Hamburger, Leeb, & Swahn, 2008). Data from the National Longitudinal Study on Adolescent Health indicate that the odds of binge drinking is 1.3 times higher in adolescents who were physically abused and 2.3 times higher in adolescents who were sexually abused (Shin, Edwards, & Heeren, 2009). Adolescents qualifying for diagnosis of alcohol abuse or dependence are more likely to have a history of sexual or physical abuse, and more frequently experienced other adverse events compared to non-affected youths (Clark,

Lesnick, & Hegedus, 1997). Additionally, physical abuse during childhood forecasts drug use (Lansford, Dodge, Pettit, & Bates, 2010). Similar to neglect, abuse during childhood facilitates development of behavior problems that segue to substance abuse in youths with a family history of SUD (Blackson et al., 1999).

Violence and conflict in the family is associated with the presence of frequent alcohol use and binge drinking in adolescents (Moore, Rothwell, & Segrott, 2010). Furthermore, poor family functioning, encompassing suboptimal bonding and poor communication, is associated with greater alcohol and drug involvement in adolescents (Anderson & Henry, 1994; Clark, Neighbors, Lesnick, Lynch, & Donovan, 1998). A perception that parental support is lacking and a poor quality relationship with parents also predict alcohol and drug use (Johnson & Pandina, 1991; Clark & Winters, 2002). Together, the evidence indicates that dysfunctional parenting and adverse family environment amplify risk for substance use and SUD in children.

1.2.2 Parenting Behaviors and Child Attachment to Parents

Quality of parent-child attachment is the joint product of parenting style and child's characteristics. Poor quality of attachment is likely to ensue when parents are not sensitive to the child's needs, particularly when distressed (Nolte, Guiney, Fonagy, Mayes & Luyten, 2011; Brook, Brook, & Whiteman, 2003). Parent-child conflict undermines parental responsiveness to children, thereby further hampering parent-child attachment (Menees & Segrin, 2000; Brown, 1988; Nolte et al., 2011). Deficiencies in other aspects of caregiving that impede attachment include low parental monitoring and discipline (Scott, Briskman, Woolgar, Humayun, & O'Connor, 2011). Adverse environment and maltreatment are also detrimental to children's attachment security (Cyr, Euser, Bakermans-Kranenburgh, & van Ijzendoorn, 2010). Inasmuch

as attachment is influenced by the quality of parent-child interactions, it is amenable to alterations in parallel with changes in parenting style and caregiving during the child's development (Thompson, Lamb, & Estes, 1982; Vaughn, Egeland, Sroufe, & Waters, 1979). Thus, showing that attachment is related to risk for SUD identifies new opportunities for prevention.

Four major attachment patterns directly linked to different parenting styles have been identified in young children: secure, anxious/avoidant, anxious/resistant, and disorganized (Ainsworth, Blehar, Waters, & Wall, 1978; Ainsworth, 1985b; Main & Solomon, 1986). Attachment patterns that young children exhibit during the *Strange Situation* test (Ainsworth et al., 1978) and parenting styles to which they are linked are summarized in Table 1.2. Attachment by the time of adolescence is a result of internal representational models constructed from experienced history of parental caregiving. Using the *Inventory of Parent and Peer Attachment* (IPPA; Armsden & Greenberg, 1987) to assess affective/cognitive expectations in the internal representational models of attachment and confidence in their parents' commitment (Weiss, 1982; Bretherton, 1985) reveals three attachment dimensions reflecting *Trust*, *Communication* and *Alienation*. Positive emotional and cognitive experiences related to accessibility to and responsiveness of parents depicts the *Trust* dimension. Parent-child interactions in which parents demonstrate sensitivity and respect towards the child is captured by the *Communication* aspect of attachment. Negative experiences resulting from unresponsive parents denote the *Alienation* aspect of attachment.

Table 1.2: Child Attachment Patterns and Parenting Styles During Strange Situation Test

Classification	Child's Attachment Pattern	Mother's Parenting Style
Secure	<ul style="list-style-type: none">-Cries during separation from parent.-Greets parent positively upon reunion.-After brief physical contact, settles and returns to play.-Compliant with parent's commands	<ul style="list-style-type: none">-More sensitive and responsive to child's distress and crying.-Responsive to child's signals for physical contact.-Less rejecting and ignoring.
Anxious/ Avoidant	<ul style="list-style-type: none">-Does not cry during separation from parent.-Avoids and ignores parent upon reunion-Unemotional and expressions of anger are absent.-Not compliant with parent's commands.	<ul style="list-style-type: none">-Most rejecting.-Shows strong aversion to physical contact with child.-Have feelings anger and irritation towards child.
Anxious/ Resistant	<ul style="list-style-type: none">-Preoccupied with parent during separation.-Actively angry, alternating between seeking and resisting parent contact upon reunion.-Fails to settle and return to exploration upon reunion.-Responds to parent's commands with anger.	<ul style="list-style-type: none">-Tends to ignore child's distress and attempts for close proximity.-Inconsistent responding to bids for close contact.-Fails to offer contact.
Disorganized	<ul style="list-style-type: none">-Disorganized behaviors displayed in parent's presence e.g., cling to parent while leaning away and failed attempts at seeking proximity to parent.-Exhibits elevated anxiety.-Suffers from confusion of parent as a source of protection and danger.	<ul style="list-style-type: none">-Acts as a figure of fear and reassurance to child.-Inconsistent responding.-Exhibit higher rates child maltreatment including physical abuse.

Adapted from Main (1996).

1.3 ATTACHMENT TO PARENTS AND RISK FOR SUD

Attachment is defined as an enduring affectional bond that an individual has toward significant others such as family, friends, and close associates (Ainsworth et al., 1978; Bowlby, 1969/1982, 1973, 1980; Hinde, 1982; Sroufe, 1979). Affectional bonds are long-lived ties in which the dyadic partners are unique and non-interchangeable. Involuntary separation induces distress (Ainsworth, 1985a, 1991; Bowlby, 1969/1982, 1973; Elicker, Englund & Sroufe, 1992). Bowlby (1969/1982, 1973, 1980) conceptualized attachment in infants as a system of organized behavior patterns, such as crying and clinging, that promote or retain proximity to a parent. This behavior system dynamically adapts to the requirements and challenges of environmental conditions (Mikulincer & Shaver, 2007). Specifically, children express attachment behaviors to attain proximity to a caregiver in response to distress from perceived or actual threat (Nolte et al., 2011). In turn, parents possess a complementary caregiving behavior system that promotes proximity keeping, attentiveness, and sensitivity to provide protection.

By the middle of the first year after birth, infants have the capability to bond with and form representational models of their parents as the principal attachment figures. These attachment bonds persist throughout life. At older ages, attachment is less dependent, however, on the physical presence of parents, but rather is contingent on the internal working models that may be called upon in different contexts to alleviate distress (Bowlby, 1973; Bretherton & Munholland, 2008; Mikulincer & Shaver, 2007). Armsden and Greenberg (1987) conceptualized attachment to parents in older adolescents as the feeling that their parents understand and respect their needs and desires, perception that their parents are sensitive and responsive to their emotional states, and helpful with their concerns. Hence, attachment after childhood manifests as

the belief that parents are allies and a source of protection rather than a dependence on their physical presence (Bowlby 1969/1982; Fallu et al., 2010).

Securely attached individuals are better able to tolerate negative affect and stress (Sroufe, 1996; Ditzen et al., 2008). Attachment relationships also provide individuals with a secure base from which they can freely explore their environment and master environmental challenges. Trust and mutual respect emanating from secure attachment positively influence the prospect of gaining independence from parents and with mature self-identity (Bloom, 1980; Bos, 1975; Lapsley, Rice, & Fitzgerald, 1990). Secure attachment to parents is also associated with life satisfaction, school achievement, interpersonal competence, self-esteem, self-efficacy and psychological adjustment (Armsden & Greenberg, 1987; Buhrmester, 1990; Bukowski, Hoza, & Boivin, 1993; Hartup, 1996; Nickerson & Nagle, 2004; Arbona & Power, 2003; Thompson, 1999). With effective affect regulation and a secure base, individuals can, therefore, enter new environments that require adaptation and recruit additional supportive relationships to enhance resilience (Fredrickson, 2001; Masten & Obradovic, 2008). Adolescents who report strong satisfaction with help and support from parents and peers also express better psychological well-being (Burke & Weir, 1978).

Poor parental responsiveness to children's attachment behaviors that attempt to elicit caregiving, on the other hand, have lasting adverse effects on physiological and psychological development (Gunnar & Quevedo, 2007, 2008; Nugent, Tyrka, Carpenter, & Price, 2011), including depression, stress and anxiety (Nolte, et al., 2011; Papini & Roggman, 1992; Papini, Roggman, & Anderson, 1991). Repetitive failure to elicit caregiving responses reinforces expectations of unreliable attachment figures leading to hyper-vigilance in anticipation of threats (Mikulincer & Shaver, 2008). Insecurely attached children experience, therefore, fear of

abandonment in threatening situations and associated anxiety concomitant to extended hyper-vigilance (Sroufe, 1996; Weinfield, Sroufe, Egeland, & Carlson, 1999; Warren, Huston, Egeland, & Sroufe, 1997) as well as psychiatric disorders in adulthood (de Ruiter & van Ijzendoorn, 1992; Cassidy, 1995). In summary, quality of attachment constitutes a dynamic system of parent-child interactions that impacts child's risk for psychopathology.

1.3.1 Relationship Between Attachment and Risk for SUD in Children

Adolescents who have strong attachment to their fathers and mothers demonstrate psychiatric adjustment and fewer interpersonal problems than youths with poor attachment to parents (Armsden & Greenberg, 1987; Cavell, Jones, Runyan, Constantin-Page, & Velasquez, 1993; Papini et al., 1991). Quality of parent-child attachment also impacts substance use and SUD risk in children (Ridenour, Clark, & Cottler, 2009; Jessor & Jessor, 1977; Kim, 1979; Chassin et al., 1981; Krohn, Massey, Skinner, & Lauer, 1983). To illustrate, disrupted parent-child relationships leads to lower parental engagement and more conflictual interactions which in turn heightens risk for substance use (Blackson & Tarter, 1994; Tarter, 2002). Data from the National Longitudinal Study of Adolescent Health also indicate that good parent-adolescent attachment lowers the probability of drug and alcohol problems one year later (Kopak, Chen, Haas, & Gillmore, 2012). Strong familial attachment (Tolan, Gorman-Smith, Huesmann, & Zelli, 1997) also lowers the frequency of current and lifetime alcohol and drug use in high school students (Peterson, Buser, & Westburg, 2010). In one study, attachment to parents was found to have a sensitivity of 62.5% for detecting substance use in adolescents (Arthur et al., 2007).

Besides a direct relationship with substance use and SUD, poor attachment to parents promotes development of psychological characteristics that bias children and adolescents

towards psychopathology that, in turn, increases risk for substance use. Attachment representations account for unique variance in indicators of psychological adjustment, independent of other measures of the parent-child relationship (Scott et al., 2011). Insecure attachment in individuals during middle childhood (about ages 4-6 years) forecasts greater externalizing behavior problems featured by aggressive and norm-breaking behavior and oppositional-defiant disorder symptoms as well as emotional difficulties (Bohlin, Eninger, Brocki, & Thorell, 2012; Dubois-Comtois, Moss, Cyr, & Pascuzzo, 2013; Scott et al., 2011). Poor attachment to parents in 10-12 year old children correlates with conduct disorder symptoms (Zhai, Kirisci, Tarter, & Ridenour, 2014). Externalizing problems during childhood, including conduct disorder and other disruptive behavior disorders, increase risk of SUD at a young age (Biederman, et al., 1997; Cadoret, Yates, Troughton, Woodworth, & Stewart, 1995; Wilens & Biederman, 1993; Wilens, Biederman, Mick, Faraone, & Spencer, 1997; Clark, Moss et al., 1997; Armstrong & Costello, 2002). Behavioral disinhibition that underlies these externalizing problems is a critical component in the developmental pathway of SUD (Iacono, Malone, & McGue, 2008). Furthermore, poor attachment in early adolescence is associated with greater aggressive and non-aggressive antisocial behaviors, which presage substance use (Marcus & Betzer, 1996; Windle, 1990, 1993). Overall, the aggregate evidence indicates that attachment is a critical psychosocial factor that directly and indirectly predicts substance use and SUD risk. Understanding SUD etiology, therefore, requires taking into account parent-child attachment.

1.3.2 Youth Attachment to Parents Scale and Children's SUD

The etiological mechanisms underlying attachment processes promoting SUD risk are not well understood. To address this gap in the research, the *Youth Attachment to Parents Scale (YAPS;*

Zhai et al., 2014) was developed with longitudinal data obtained on high- and average-risk youths when they were 10-12, 14, 16, 18, and 22 years of age. This instrument was used to prospectively study the role of attachment to parents in the etiology of substance use and SUD. A longitudinal paradigm has advantages over cross-sectional designs (Essau, 2011), specifically the opportunity to delineate the developmental progression and impact of attachment on SUD etiology prior to and during substance use.

The method of developing the *YAPS* and its psychometric properties were thoroughly detailed in the study by Zhai et al. (2014) and in [Chapter 3](#). Briefly, the *YAPS* measures on a Likert scale adolescents' perception of attachment to their fathers and mothers. Studies utilizing the *People In My Life* scale (*PIML*, Cook, Greenberg, & Kusche, 1995; Ridenour, Greenberg, & Cook, 2006) demonstrated that the *IPPA* was adaptable to younger adolescents. Hence, the *YAPS* was derived in 10-12 year old youths containing three subscales: *Communication*, *Trust*, and *Alienation* paralleling the *IPPA* (Armsden & Greenberg, 1982) and *PIML* (Cook et al., 1995). Notably, Zhai et al. (2014) demonstrated that attachment at age 10-12 to fathers and mothers correlated with frequency of cannabis use at ages 16 and 19 years and alcohol use frequency at age 19. Attachment to fathers and mothers also predicted neurobehavior disinhibition at age 16 previously shown to presage SUD (Tarter et al., 2003). Furthermore, attachment to fathers and mothers at age 10-12 also forecasted SUD at age 22 indirectly through severity of neurobehavior disinhibition age 16. This study by Zhai et al. (2014), demonstrating the predictive validity of the *YAPS*, constitutes the foundation for this study.

1.4 ATTACHMENT MEDIATES AND MODERATES THE ASSOCIATION BETWEEN PARENTAL SUD AND DEVELOPMENT OF SUD IN CHILDREN

In light of the effects of attachment and dysfunctional parenting behavior on children's risk for substance use and SUD, the possibility is raised that transmission of SUD from parents to children may occur indirectly through quality of children's attachment to parents. The limited available evidence suggesting that attachment quality is a mediator or moderator of child's risk for SUD is discussed below.

1.4.1 Parental SUD Impedes Attachment and Parenting Style

The detrimental effects of parental substance abuse on the quality of parent-child attachment are evident across multiple developmental periods. Alcohol problems in fathers are associated with low sensitivity to their infants, evidenced as negative affect, low positive engagement and low responding which, in turn, is associated with elevated risk for insecure attachment (Eiden, Edwards, & Leonard, 2002). In a prospective study of adolescents, it was found that parental SUD is associated with low parent-child emotional bonding and elevated relationship strain (Hoffmann & Su, 1998). Furthermore, adult children whose mothers have drinking problems report lower attachment to both parents compared to adult children of non-alcoholic parents (Kelley et al., 2008). A history of SUD in parents disrupts the family environment and hampers parenting in part due to involvement with substance consumption (Hill, Nord, & Blow, 1992). Preoccupation with drug and alcohol use, a cardinal feature of SUD, impedes attachment security in children. Time away from their children to procure substances and the legal consequences of substance use such as incarceration further militate against secure attachment. Moreover, the

physiological effects of substance use causing low frustration tolerance, elevated agitation, and propensity for physical violence jeopardize attachment (Ammerman, Kolko, Kirisci, Blackson, & Dawes, 1999).

Substantial research demonstrates that parental SUD is associated with poor quality parenting and disruptive family environment, which increase risk for child maltreatment (Bays, 1990; Chasnoff & Lowder, 1999). Consequently, adverse environment and child maltreatment are detrimental to attachment security (Cyr et al., 2010). Data from the Epidemiological Catchment Area survey indicate that parental substance abuse is strongly associated with child neglect and abuse (Kelleher, Chaffin, Hollenberg, & Fischer 1994; Chaffin, Kelleher, & Hollenberg, 1996). Other studies also report a high rate of childhood neglect and abuse in adolescents and adults with SUD (Schaefer et al., 1988; Toray et al., 1991; Bays, 1990). Boys whose fathers have a history of SUD experience more severe neglect than boys whose fathers do not have a psychiatric disorder (Kirisci et al., 2001). In addition, paternal SUD is related to a propensity for abusive behavior toward their children (Blackson et al., 1999).

Parents who actively use drugs and alcohol demonstrate deficiencies in parenting skills that exacerbate risk for SUD in their children (Dunn et al., 2002; Arria, Mericle, Meyers, & Winters, 2012). Suboptimal supervision and monitoring of children (Chilcoat, Breslau, & Anthony, 1996; Latendresse et al., 2008; Chassin, Pillow, Curran, Molina, & Barrera, 1993; Dishion, Capaldi, & Yoerger, 1999) and low warmth, responsiveness, and physical and verbal engagement, accompanied by harsh and inconsistent discipline (Solis, Shadur, Burns, & Hussong, 2012; Barnow, Schuckit, Lucht, John, & Freyberger, 2002; Kandel, 1990; Tarter, Blackson, Martin, Loeber, & Moss, 1993) have been reported in families where a parent has SUD. Furthermore, children commonly describe having less satisfying and more conflictual

interactions with substance abusing parents (Johnson & Leff, 1999; Brook, Brook, Arencibia-Mireles, Richter, & Whiteman, 2001; Johnson, Cohen, Chen, Kasen, & Brook, 2006; El-Sheikh & Flanagan, 2001). These findings suggest that parental SUD indirectly promotes children's substance use and SUD via attachment quality.

1.4.2 Is the Association Between Parental SUD and Child's SUD Mediated or Moderated by Attachment?

The literature reviewed above suggests that attachment to parents may mediate or moderate the association between parents' SUD and their children's SUD. The theoretical model of attachment as a mediator is depicted in Figure 1.1a. In mediation, the independent variable influences the dependent variable indirectly through its effects on the mediator. This model specifies that parents' SUD impedes their children's attachment quality which, in turn, increases their children's SUD risk. Mediation is determined by significant association between parents' SUD-attachment and attachment-children's SUD, as well as reduced strength of association between parents' and children's SUD after including attachment as a mediator in the model. The theoretical model of attachment as a moderator is depicted in Figure 1.1b. Moderation indicates the conditions in which the independent variable affects the dependent variable. In this model, attachment is theorized to augment the strength and direction of the association between parents' SUD and the risk for SUD in their children. Moderation is determined by significant interaction between parents' SUD and attachment on children's SUD.

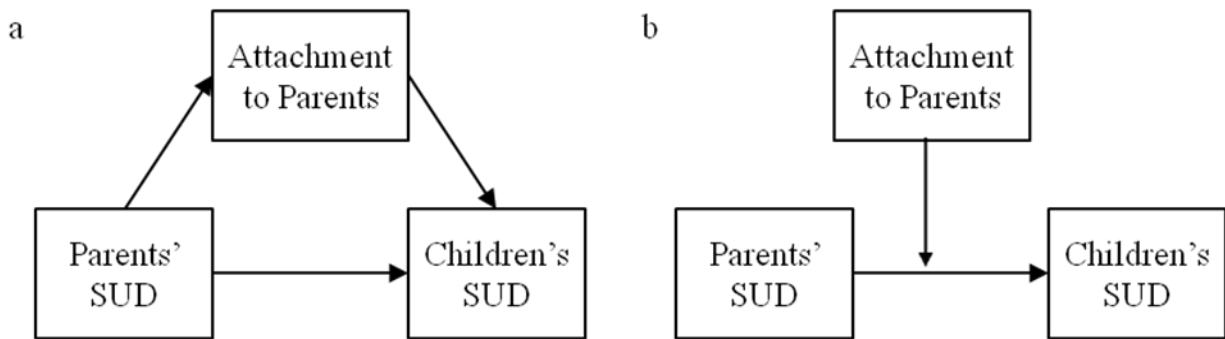


Figure 1.1: Theoretical Models of Attachment to Parents Accounting for Association between SUD in Parents and SUD in Their Children. A. Mediation Model. B. Moderation Model

1.4.2.1 Mediation Model: Parent and adolescent problem behaviors are linked through ineffective and abusive parenting (Dogan, Conger, Kim, & Masyn, 2007; Conger & Simons, 1997; Laub & Sampson, 1988; Patterson & Capaldi, 1991; Smith & Stern, 1997). Parental monitoring, discipline, and closeness mediate the relationship between substance use problems in parents and use of licit and illicit substances in their adolescent children (Chassin et al., 1993; Chassin, Curran, Hussong, & Colder, 1996; King & Chassin, 2004; Shorey et al., 2013; Latendresse et al., 2008). The association between antisocial behavior in parents (which includes substance use) and externalizing behavior in their adolescent children is mediated by parental attachment (Thornberry, Freeman-Gallant, & Lovegrove, 2009).

1.4.2.2 Moderation Model: Parental warmth, closeness, and supervision moderate the association between substance use in parents and their children's substance use (Cleveland, Reavy, Mallett, Turrisi, & White, 2014; Ennett et al., 2008; Zhang, Welte, & Wieczorek, 1999), especially in families where there is low maternal warmth and closeness. Family cohesion also moderates the association between substance use problems in parents and substance abuse in

their children (Farrell, Barnes, & Banerjee, 1995; Hoffmann & Cerbone, 2002). In summary, the dearth of research notwithstanding the available evidence points to the role of attachment as both mediator and moderator of the association between parental SUD and their children's SUD. Employing a prospective experimental design, this project affords the opportunity to more accurately understand how attachment bears on children's risk for developing SUD.

1.5 HYPOTHESES

Research has not yet been conducted to determine how parent-child attachment bears on the relationship between parental SUD and their children's risk for developing SUD. Accordingly, the first objective in this research involved determining the aspect of parental substance involvement that predicts substance involvement in their sons. It was hypothesized that parental substance use severity, not SUD, was the better predictor of substance involvement (substance use and SUD) in their biological sons. If confirmed, it suggests that the parents' substance use behavior, relative to the parents' disorder severity, is a better predictor of severity of substance use and SUD outcome in their children. A corollary objective focused on determining the relationship between parental supervision on their sons' substance involvement. In addition, it was hypothesized that substance use in parents mediates the association between parental SUD and substance involvement in their sons. If confirmed, it indicates that the parents' SUD increases the risk of substance use in their children via parents' substance use. These aims, addressed in [Chapter 2](#), used linear regression analysis to delineate the best parental substance involvement indicator of future substance involvement in their sons. Structural equation

modeling was also employed to clarify whether parental substance use severity is a mediator of the association between their SUD and substance involvement in their sons.

The second aim in this research was directed at evaluating whether attachment to parents is an independent predictor of SUD in their sons. It was hypothesized that attachment to parents accounts for significant variance in severity of substance involvement in their sons after controlling for parental substance use and parental supervision. If confirmed, it suggests that attachment to parents independently predicts children's substance involvement beyond the effects of parents' substance use and other parenting factors, including parental supervision. A corollary objective was aimed at determining the relationship between parental supervision, relative to the influence of parents' substance use, on substance involvement in their sons. This research objective, constituting [Chapter 3](#), was addressed using multiple regression to elucidate the relationship between attachment and substance involvement in sons while controlling for parental supervision and parental substance use. Cox regression analysis was also employed to examine the association between attachment to parents and substance use initiation, first regular use, and first problems with use, while controlling for parental substance use severity. Significant association suggests that attachment to parents also contributes to the rate of developing substance use behaviors and problems consequent to substance use.

The third research objective, comprising [Chapter 4](#), was directed at developing a model to describe the role of attachment on substance involvement in sons of SUD parents. It was hypothesized that attachment to parents mediates as well as moderates the association between parental substance use and sons' substance use. If confirmed, it suggests that attachment is part of the etiological pathway by which substance use behavior in parents increases substance use in their children as well as alters the strength of the effect of parents' substance use behavior on

children's substance use. Structural equation modeling was employed to clarify whether attachment to parents mediated and/or moderated the association between parental substance use and sons' substance use. Furthermore, the practical utility of the attachment factor was explored by investigating its ability to predict illicit substance use in adolescents. Significant association indicates that attachment to parents may be an indicator of early risk for substance use in youths. Correlation analysis followed by logistic regression analysis were conducted to elucidate the extent that attachment to parents predicts illicit substance use during adolescence.

1.6 STUDY INNOVATIONS

This is the first longitudinal study aimed at elucidating the role of children's attachment to parents on the development of substance involvement and SUD. Clarifying the contribution of parental substance use severity, SUD, and attachment yields a more refined understanding of children's current risk and development of SUD. Furthermore, this project differentiated substance use behavior and its SUD consequence in parents on their children's risk for SUD. Lastly, modeling the role of attachment as a mediator and/or moderator using a prospective paradigm not only clarifies its role in SUD etiology but also informs interventions aimed at preventing SUD. By demonstrating that attachment is a unique contributor to children's SUD risk, this study identifies a potential intervention node for high-risk youths.

**2.0 CHAPTER 2: PARENTAL SUBSTANCE USE SEVERITY IN RELATION TO
SONS' SUBSTANCE USE AND SUBSTANCE USE DISORDER (SUD) SEVERITY**

2.1 INTRODUCTION

Parents' behaviors involving drugs of abuse that reflect positive beliefs about and permissive attitudes towards substance use are critical to increasing the risk for child's substance use leading to SUD. Additionally, parental SUD-associated poor parenting skills in supervision and monitoring, with the purpose of overseeing and regulating child's behavior as well as social relationships, increase children's risk of norm-violating behavior and association with deviant peer groups leading to substance use. Risky behaviors and positive attitudes towards substance use may be learned through interactions with closely associated individuals who model such behaviors (Petratis, Flay, & Miller, 1995; Akers, 1977; Bandura, 1986). Furthermore, closely associated individuals may also promote and reinforce risky behaviors and attitudes towards drugs of abuse in substance naive youth.

While SUD in parents contribute to their child's risk, it does not capture the full range of substance involvement and behavior in which the parents are engaged. In particular, parental use of certain substances may not reach clinical diagnosis, but can nonetheless influence child's attitudes towards substance use. Parental substance involvement has multiple facets that may influence the child's risk to various effects. These multiple substance involvement parameters include the severity of parental substance use, the severity of the parents' clinical diagnosis, the number of parents with an SUD diagnosis, as well as the duration of parent's substance use and exposure in child's lifetime. The purpose of this chapter is to determine which of the parental substance involvement parameters most strongly and consistently predicts sons' substance use and SUD severity. This chapter also examines the contribution of parental supervision on the severity of sons' substance use. Furthermore, a model is put forward demonstrating the mediation effect of behavioral substance involvement in parents in the association between the disorder of

SUD in parents and the behavioral substance involvement in biological sons leading their SUD diagnosis. These models will be used as the starting point for modeling the role of attachment in SUD etiology in subsequent chapters. The results of these analyses inform the understanding of the components in parental substance involvement and behavior that facilitates transmission of SUD risk from parent to biological offspring.

2.2 METHODS

2.2.1 Participants

The participants were 499 families in which the father had a biological son enrolled in a longitudinal investigation directed at elucidating the etiology of SUD. The fathers (probands) qualified for lifetime SUD diagnosis consequent to use of an illegal drug (SUD+; $n = 249$) or had no adult onset Axis I or II psychiatric disorder (SUD-; $n = 250$). Recruitment procedures have been described in previous reports (Tarter, Kirisci, Ridenour, & Vanyukov, 2008; Zhai et al., 2014). Briefly, multiple recruitment methods were utilized due to the low prevalence in the population of men who satisfied diagnostic criteria, had a 10-12 year old biological son, and had a spouse who was the biological mother of the child willing to participate in the longitudinal study. The current study focuses on boys because recruitment of girls commenced several years after boys resulting in an insufficient number of girls to perform valid statistical analyses. Accordingly, the SUD+ men were recruited using public service announcements, advertisements in print and electronic media, and random-digit dialing conducted by a market research firm, and from treatment facilities. Approximately 20% of the SUD+ men were recruited from treatment

facilities. The SUD- fathers were identified using the same procedures except that none were obtained from treatment facilities. Forty-nine percent of men who met study criteria agreed to participate. Exclusion criteria, limited to factors that could invalidate the results, were positive urine drug or breath alcohol screen, neurological disease, physical disability, uncorrected sensory impairment, psychosis, and fetal alcohol effects determined from mother's report of her drinking history and direct physical examination of the child. Subjects were additionally required to reside with at least one biological parent (residing with both parents $n = 432$, only fathers $n = 13$, only mothers = 54).

Table 2.1: Characteristics of Sons at Baseline (10-12 years of age)

	Retained		Attrited		t	p
	Mean	SD	Mean	SD		
Family Socioeconomic Status	42.00	13.47	38.88	12.88	-2.53	.012
Full-Scale IQ	110.26	15.84	103.65	15.22	-4.55	< .001
	n	%	n	%	χ^2	p
Ethnicity					1.16	0.56
European American	236	76.38	137	74.46		
African American	65	21.04	39	21.20		
Other	8	2.59	8	4.35		
Risk Group					0.19	0.67
SUD+ Fathers	150	48.54	93	50.54		
SUD- Fathers	159	51.46	91	49.46		

Baseline evaluation was conducted when the boys were 10-12 years of age. Follow-up study was conducted when the sons attained 12-14, 16, 19, and 22 years of age. Attrition was defined as either a failure to locate the individual or his refusal to participate between the baseline and the age 22 evaluations. Discounting six subjects who were not yet old enough to have undergone the final follow-up evaluation at the time the current study was conducted, 37.3% of the sample did not participate in the age 22 assessment. As shown in Table 2.1, participants who attrited had lower full scale intelligence quotient on the *Wechsler Intelligence*

Scale for Children, 3rd edition (Wechsler, 1991). However, both the retained and attrited participants scored in the normal range of intelligence at baseline. The participants who attrited before age 22 also scored lower on the *Hollingshead Index* (Hollingshead, 1991) of socioeconomic status. Nevertheless, retained and attrited participants were from the lower middle socioeconomic stratum. The same sample was used in analyses in Chapters 3 and 4.

2.2.2 Instrumentation

There are multiple indicators of severity of SUD and substance use behavior. Because the particular variables in parents that best predict children's SUD risk has not been systematically researched, substance use and SUD in parents were measured using several methodologies:

2.2.2.1 Substance Use Severity Index (SUSI): Abusable substances have specific pharmacological mechanisms of action; however, considerable genetic and environmental variance is shared between consumption of different drugs. Indeed, substance use involvement fits a unidimensional model explaining 63.5% of the variance in lifetime drug use (Hu et al., 1997). The *SUSI* quantifies severity of substance use involvement spanning ten drug classes (Kirisici, Vanyukov, Dunn, & Tarter, 2002). The *SUSI* has the advantage of depicting the subjects on a continuous severity scale rather than assigning dichotomous classifications of "use" or "no use". As described below, the *SUSI* utilized factor scores, which reflected the latent trait accounting for shared covariance among observed substance use items, rather than a simple sum of substances used.

The method of development and psychometric properties of the *SUSI* have been previously reported (Kirisici et al., 2002). Briefly, the *Drug Use Chart* (Center for Education and

Drug Abuse Research, 1989) measuring lifetime drug use pertaining to 10 different psychoactive substance categories were used as indicator items for the parents and their sons at adulthood. For sons, assessment of adulthood substance use outcomes was at age 22. The items, capturing the ten categories used in the Epidemiologic Catchment Area Study (Anthony & Helzer, 1991) were: alcohol (beer, wine, liquor), cannabis (marijuana), cocaine/crack, opiates (heroin, codeine, morphine, methadone, opium), amphetamines and methylphenidate (Ritalin), sedatives (barbiturates, Quaaludes, Seconal, Xanax, Librium, Valium, etc.), tobacco (smoking tobacco, chewing tobacco, snuff tobacco), hallucinogens (LSD, mescaline, peyote, etc.), PCP, and inhalants (amyl nitrite, nitrous oxide, glue, gasoline, etc.). If the participant had ever tried a drug in a particular category, a score of 1 was assigned; otherwise, a score of 0 was assigned. The prevalence of use of each drug category is shown in Table 2.2. Confirmatory factor analysis using drug category as the indicator items revealed a unidimensional trait, termed substance use severity index (*SUSI*) with satisfactory model-data fit in males ($\chi^2 = 40.14$, $df = 25$, $p < .03$, RMSEA = .032) and females ($\chi^2 = 35.07$, $df = 25$, $p < .09$, RMSEA = .026) (Kirisci et al., 2002). Extending these findings with replication of the method but excluding alcohol and tobacco also yielded a continuous trait. Thus, this scale measured severity of illicit substance use (*Illicit SUSI*). Principal Component Analysis revealed a one-factor solution (1st eigenvalue = 3.59, 2nd eigenvalue < 1) accounting for 51.3% of the inter-item variance. Cronbach's Alpha was .83. The factor scores, having normal distribution, documented severity of use of illicit substances in fathers, mothers, and sons. As the fathers' and mothers' *SUSI* scores were significantly correlated (Pearson $r = .497$, $p < .001$), an overall parental *SUSI* score was created by performing Principal Component Analysis on the indicator items from fathers and mothers together (Cronbach's Alpha = .84), followed by summing their factor scores (mean = 0, sd = 1). As 37.3% of the sons did not

Table 2.2: Substance Use in the Sample

	Fathers	Mothers	Sons	Fathers vs. Mothers	Fathers vs. Sons	Mothers vs. Sons
Substance	% (n = 445)	% (n = 486)	% (n = 309)	χ^2 (df = 1)	χ^2 (df = 1)	χ^2 (df = 1)
Alcohol	98.9	97.3	94.5	2.98	12.34***	4.11*
Amphetamine	48.3	29.8	11.7	33.69***	110.39***	35.22***
Crack/Cocaine	47.6	26.2	17.5	45.82***	72.68***	8.22**
Opiate	46.7	45.9	22.0	.07	48.08***	46.29***
Sedative	39.1	25.6	10.4	19.34***	75.89***	27.81***
Hallucinogen	38.9	15.9	26.9	62.18***	11.74***	14.05***
PCP	15.5	5.4	0.3	25.93***	49.91***	14.61***
Cannabis	74.8	64.7	63.1	11.30***	11.94***	.20
Inhalant	32.8	16.1	10.0	35.31***	52.67***	5.89*
Tobacco	82.2	63.8	65.0	39.53***	28.92***	.12

*p ≤ .05, **p ≤ .01, ***p ≤ .001

return for the age 22 assessment and six sons were not yet old enough for the follow-up at the time of the current study, *SUSI* was measured in $n = 309$ sons. Furthermore, as sons were required to reside with at least one biological parent (both parents $n = 432$, only fathers $n = 13$, only mothers = 54), *SUSI* was measured in $n = 445$ fathers and $n = 486$ mothers in accordance with the inclusion criteria.

2.2.2.2 Substance Use Disorder Severity Index (SUDSI): A significant portion of the genetic contribution of risk for SUD is common across all categories in the Diagnostic and Statistical Manual of the American Psychiatric Association (Tsuang et al., 1998; Vanyukov, Kirisci et al., 2003; Vanyukov, Tarter et al., 2003). The *SUDSI* was derived to quantify the severity of SUD taking into account the manifold permutations of co-occurring disorders. Thus, SUD severity was measured in addition to dichotomous SUD presence or absence designations.

The method of development and psychometric properties of the *SUDSI* was previously reported (Kirisci et al., 2006). Briefly, parents and adult sons were administered an expanded version of the *Structured Clinical Interview for Diagnosis (SCID; Spitzer, Williams, Gibbon, & First, 1990)*. Sons prior to reaching age 18 were administered the *Kiddie-Schedule for Affective Disorders and Schizophrenia (K-SADS; Clark, Pollock, Mezzich, Cornelius, & Martin, 2001)*. The diagnostic formulation of SUD was performed by a committee consisting of a psychiatrist certified in addiction psychiatry, another psychiatrist or psychologist, and master-level clinical associates who conducted the interviews. If the participant received an SUD diagnosis, a score of 1 was assigned; otherwise, a score of 0 was assigned. The rates for the various lifetime SUDs are presented in Table 2.3. Confirmatory factor analysis using lifetime SUD diagnoses (abuse or

Table 2.3: Lifetime SUD in the Sample

	Fathers	Mothers	Sons	Fathers vs. Mothers	Fathers vs. Sons	Mothers vs. Sons
Substance	% (n = 445)	% (n = 486)	% (n = 499)	χ^2 (df = 1)	χ^2 (df = 1)	χ^2 (df = 1)
Alcohol	41.3	18.8	31.3	56.56***	10.383***	20.28***
Amphetamine	7.4	3.1	1.8	8.82**	17.427***	1.73
Cannabis	33.0	9.7	32.7	76.33***	.01	77.06***
Cocaine	20.9	6.8	4.8	39.21***	56.08***	1.82
Hallucinogen	2.9	0.6	3.4	7.26**	.18	9.57**
Inhalant	1.3	0.8	0	.59	6.77**	4.14*
Opiate	9.7	4.3	6.6	10.25***	2.96	2.44
PCP	1.3	0	0	6.57**	6.77**	NA
Sedative	4.5	2.7	1.2	2.21	9.52**	2.85

*p ≤ .05, **p ≤ .01, ***p ≤ .001

dependence) as the indicator items has previously revealed a unidimensional trait with acceptable model-data fit in fathers ($\chi^2 = 21.06$, $df = 17$, $p = .22$, $RMSEA = .022$), mothers ($\chi^2 = 22.56$, $df = 27$, $p = .75$, $RMSEA < .001$), and sons ($\chi^2 = 11.68$, $df = 20$, $p = .93$, $RMSEA < .001$) (Kirisici et al., 2006). Due to the lack of occurrence in the current sample of mothers and sons, PCP and inhalant use disorder diagnoses were omitted from the *SUDSI* to maintain consistency between all subjects. Extending these findings with replication of the method but excluding alcohol also yielded a continuous trait. Thus, this scale measured severity of illicit substance use disorder (*Illicit SUDSI*). Principal component analysis revealed a one-factor solution (1st eigenvalue = 2.09, 2nd eigenvalue < 1) accounting for 34.82% of the variance. Cronbach's Alpha was .62. The factor score documented severity of SUD. As the fathers' and mothers' *SUDSI* scores were significantly correlated (Pearson $r = .364$, $p < .001$), an overall parental *SUDSI* score was created by performing Principal Component Analysis on the SUD diagnoses as items from fathers and mothers together (Cronbach's Alpha = .67), followed by summing the factor scores between both parents (mean = 0, sd = 1). It is also noted that the *SUDSI* used factors scores, which reflected the latent trait accounting for shared covariance among the different SUDs, rather than a simple sum of SUD diagnoses. As the *SUDSI* was derived with items indicating lifetime SUD, data were accrued from all available sons ($n = 499$). SUD data were also accrued from $n = 445$ fathers and $n = 486$ mothers that resided with their biological sons in accordance with inclusion criteria.

2.2.2.3 Number of SUD Parents: Previous reports have shown that individuals having two parents diagnosed with SUD exhibit more severe alcohol use, family, and psychiatric problems (Schuckit, 1984; Stabenau, 1984; Boyd, Plemon, Schwartz, Jonson, & Pickens, 1999). Number of parents with SUD is a predictor of early age alcohol use (Westermeyer, Yoon, & Thuras). The

number of parents (0, 1, or 2) with lifetime SUD diagnosis was determined from the *Structured Clinical Interview for Diagnosis (SCID; Spitzer et al., 1990)*. Statistical analyses focused on families in which both biological fathers and mothers resided in the same household ($n = 432$). In this sample, 47.3% of families had no parental SUD, 35.8% had only one parent with SUD, and 16.9% had both parents with SUD.

2.2.2.4 Parental Substance Use Duration: The relationship between parental substance use duration and offspring's substance use has received limited study (Pickens et al., 2001). The number of years the parents used each drug was recorded in the *Lifetime History of Drug Use* (Mezzich, 1989). As individuals with different substance use frequencies can still demonstrate a similar duration of use (number of years), only parents who regularly used illicit substances (at least once per month, regardless of SUD diagnosis) in the interval between sons' birth and age 10-12 baseline assessment were included in analyses (fathers: $n = 152$; mothers: $n = 144$). The *Parental Substance Use Duration* scale was calculated by summing the duration a parent engaged in any substance use not related to alcohol or nicotine (father: mean = 7.52 years, $sd = 3.9$; mothers: mean = 5.81 years, $sd = 4.3$). The prevalence and mean duration of use of each substance for fathers and mothers are shown in the left half of Tables 2.4 and 2.5.

2.2.2.5 Parental Polysubstance Use Duration: The *Parental Polysubstance Use Duration* scale was derived using self-reported *Lifetime History of Drug Use* (Mezzich, 1989). The duration a parent concurrently used more than one drug in the period between sons' birth and baseline assessment was tabulated. Quantity of consumption was not included into the parental substance use duration scales because of lack of consistency in measurement units between different drugs

Table 2.4: Duration of Regular (At Least Once Per Month) Illicit Substance Use in Fathers

Substance	Use Duration of Each Substance			Duration of Poly-Substance Use (Used Concurrently with Another Drug)		
	% (n = 152)	Mean (yrs)	sd	% (n = 152)	Mean (yrs)	sd
Amphetamine	9.21	4.4	2.88	8.55	3.88	3.09
Crack/Cocaine	43.42	5.41	3.76	32.24	5.88	10.71
Heroin	17.11	7.34	3.58	15.13	6.38	3.35
Morphine	1.97	4.35	1.33	1.32	4.02	0.5
Methadone	3.95	3.57	1.94	3.95	3.36	1.85
Barbiturate	2.63	6.05	4.23	1.97	7.24	4.28
Quaalude	.66	5.42	NA	.66	5.42	NA
Benzodiazepine	5.92	4.77	4.06	5.26	4.95	2.85
Psilocybin	.66	5.59	NA	.66	5.59	NA
Peyote	.66	.97	NA	.66	0.97	NA
PCP	2.63	5.68	4.88	1.32	8.76	1.76
Cannabis	71.71	7.19	4.15	29.61	4.99	3.36

Table 2.5: Duration of Regular (At Least Once Per Month) Illicit Substance Use in Mothers

Use Duration of Each Substance				Duration of Poly-Substance Use (Used Concurrently with Another Drug)		
Substance	% (n = 144)	Mean (yrs)	sd	% (n = 144)	Mean (yrs)	sd
Amphetamine	4.17	3.44	2.78	4.167	2.44	1.60
Crack/Cocaine	20.14	4.07	3.12	11.11	4.04	2.81
Heroin	8.33	5.44	3.70	5.56	4.87	3.89
Morphine	.69	11.64	NA	0.69	11.64	NA
Barbiturate	2.08	1.92	1.95	1.39	2.63	2.14
Benzodiazepine	8.33	4.31	3.22	6.25	2.63	2.42
Doriden	.69	6.00	NA	0.69	3.00	NA
Placidyl	.69	1.12	NA	0.69	1.12	NA
Peyote	.69	.03	NA	0.69	0.03	NA
PCP	.69	2.37	NA	0	0	NA
Cannabis	45.83	6.02	4.33	14.58	3.89	3.06

(e.g., gram of cocaine vs. "joint" of cannabis), as well as between different units of the same drug (e.g., cannabis "joint" vs. "bowl"). The prevalence and duration of use in fathers and mothers are shown in right half of Tables 2.4 and 2.5, respectively. Fathers reported a mean = 5.33 years (sd = 3.4) and mothers reported a mean = 4.08 years (sd = 3.1) of using more than one drug at the same time.

2.2.2.6 Supervision: *Supervision*, reflecting the parents' awareness of children's whereabouts and activities with peers, is associated with adolescent alcohol use (Clark, Kirisci, Mezzich, & Chung, 2008). The association between parental *Supervision* and severity of offspring's substance use and SUD severity has not, however, been examined.

The items composing the *Supervision* scale were selected from the *Loeber Youth Questionnaire* (Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998). The development and psychometric properties of the *Loeber Youth Questionnaire* have been previously described (Jacob, Moser, Windle, Loeber, & Stouthamer-Loeber, 2000). Statistical analyses focused on families in which both biological fathers and mothers resided in the same household. As in previous studies (Clark et al., 2004, 2008; Clark, Thatcher et al., 2005) 58 items pertaining to parental involvement, and hypothesized to measure constructs including supervision, communication, and emotional support, were initially selected according their face validity for psychometric analyses. Using these items, seven parent involvement subscales were developed, including the *Supervision* scale. The *Supervision* scale completed at baseline assessment (10-12 years of age) included four items referring to parents in general: (1) If your parent(s) are not home, do you leave a note for them or call them about where you are going? (2) Do your parent(s) know who you are with when you are away from home? (3) When you are out, do your parent(s) know what time you will be home? (4) When your parents are not at home, do

you know how to get in touch with them? The responses were scored on a 3 point Likert scale corresponding to "almost always", "sometimes", and "almost never". The resulting score on *Supervision* ranged from 4 (answered "almost never" on all items) to 12 (answered "almost always" on all items) with mean score = 10.43 (sd = 1.73) for the sample. Internal consistency of the scale measured by Cronbach's alpha has been reported to reach .71 (Clark, Thatcher et al., 2005). Previous studies have demonstrated an association between parental neglect consequent to SUD and biological offspring's substance use severity and SUD risk (Kirisci et al., 2001; Dunn et al., 2002). In order to thoroughly test the effects of *Supervision* referring to both parents, and overall *Youth Attachment to Parents* (see [Chapter 3](#)), which combined highly correlated fathers' and mothers' scores, overall parental *SUSI* and *SUDSI* scores were calculated from modestly, but significantly, correlated fathers' and mothers' *SUSI* and *SUDSI* scores.

2.2.3 Statistical Analysis

Analyses were performed using SPSS 19 (IBM Corp., 2010). To systematically determine which variable in parents that best predict sons' substance involvement, linear regression was performed using each indicator of severity of parental SUD diagnosis and substance use behavior as the independent variable in separate analyses. The independent variables were: fathers' *SUSI*, *SUDSI*, *Substance Use Duration*, and *Polysubstance Use Duration*; mother's *SUSI*, *SUDSI*, *Substance Use Duration*, and *Polysubstance Use Duration*; overall parental *SUSI*, overall parental *SUDSI*, number of SUD parents, and parental *Supervision*. The sons' *SUSI* as well as sons' *SUDSI* was the dependent variable in separate analyses. Furthermore, to determine whether parental *SUSI* or *SUDSI* was the best predictor of sons' liability, multiple regression analysis was performed by entering parents' *SUSI* and *SUDSI* scores conjointly as independent variables and

sons' *SUSI* score as the dependent variable. The analysis was repeated using sons' *SUDSI* score as the dependent variable. Analyses using an independent variable indicating a specific parent (father's *SUSI*, *SUDSI*, *Substance Use Duration*, *Polysubstance Use Duration*; mother's *SUSI*, *SUDSI*, *Substance Use Duration*, *Polysubstance Use Duration*) included only families in which the specific biological parent (father or mother) resided in the same household as his/her son. Additionally, analyses using an independent variable related to both parents in general (number of SUD parents, parental *Supervision*, overall parental *SUSI*, and overall parental *SUDSI*) focused on families in which both biological fathers and mothers resided in the same household. To test the effect of having one vs. two SUD parents on sons' *SUSI* and *SUDSI* scores, number of SUD parents were coded into two dummy variables: X_1 (0 parents = 1, 1 parent = 0, 2 parents = 0) and X_2 (0 parents = 0, 1 parent = 1, 2 parents = 0). The dummy variables were added as independent variables in linear regression predicting sons' *SUSI* and *SUDSI* scores. As the formulation of parental *Substance* and *Polysubstance Use Duration* did not include alcohol and tobacco use, additional linear regression analyses were performed between substance use duration variables in parents and son's *Illicit SUSI* and *Illicit SUDSI*. To keep the experiment wise Type I error rate of regression analyses at .05, false discovery rate was used to adjust the alpha for 24 total comparisons using data on fathers, mothers, and parents combined.

Pearson correlation was used to test the inter-correlation between parents' *SUSI* and *SUDSI* and sons' *SUSI* and *SUDSI* scores. A significant relationship was accepted by a p-value \leq .05. Additionally, path analysis was conducted on the relationship between *SUSI* and *SUDSI* in parents and sons using MPLUS (Muthen & Muthen, 1998-2011). χ^2 goodness of fit, root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI) were used to determine model-data fit. Mediation paths were tested using Sobel's (1982)

formula $z = \frac{b_1 b_2}{\sqrt{b_2^2 \sigma_{b_1}^2 + b_1^2 \sigma_{b_2}^2}}$; where b_1 is the regression coefficient between the independent

variable and mediator, b_2 is the coefficient between the mediator and dependent variable, and σ^2 is the square of the estimate of the standard error of the corresponding regression coefficients; as well as the method described by Baron and Kenny (1986) with the following parameters: 1) The independent variable, *SUDSI* in parents, predicts the dependent variable, *SUSI* in sons; 2) *SUDSI* in parents predicts putative mediator, *SUSI* in parents; 3) *SUSI* in parents predicts *SUSI* in sons while accounting for *SUDSI* in parents. Full mediation is presented if parents' *SUSI* reduces the association between parents' *SUDSI* and sons' *SUSI* to non significance whereas partial mediation is present if the magnitude of association is reduced but still remains significant. Mediation analyses were conducted separately for father-son, mother-son, and overall parents-sons relationships (see Figures 2.1, 2.2, and 2.3). To account for possible issues of collinearity between parental *SUSI* and *SUDSI*, parental *SUDSI* was removed from the mediation models shown in Figures 2.1b, 2.2b, and 2.3b, and tested again.

2.3 RESULTS

2.3.1 Parents' Substance Use Behavior Predicts Sons' Substance Use Severity

The correlations between fathers', mothers', overall parents', and sons' *SUSI* and *SUDSI* scores are shown in Table 2.6. Significant correlations were found between all participants' substance involvement scores.

Table 2.6: Correlation between Family *SUSI* and *SUDSI*

	1	2	3	4	5	6	7
1. Fathers' <i>SUSI</i>							
2. Mothers' <i>SUSI</i>	.50***						
3. Overall Parental <i>SUSI</i>	.90***	.83***					
4. Sons <i>SUSI</i>	.18***	.27***	.27***				
5. Fathers <i>SUDSI</i>	.75***	.41***	.70***	.11*			
6. Mothers <i>SUDSI</i>	.34***	.59***	.52***	.21***	.36***		
7. Overall Parental <i>SUDSI</i>	.70***	.59***	.75***	.19***	.89***	.75***	
8. Sons <i>SUDSI</i>	.15***	.24***	.18***	.62***	.13**	.15***	.17***

*p ≤ .05, **p ≤ .01, ***p ≤ .001

Table 2.7: Regression Analysis Predicting Sons' *SUSI*

Predictors in Parents	<i>SUSI</i> in Sons	
	R ²	b
<i>SUSI</i>		
Fathers	.03	.18**
Mothers	.07	.27***
Overall Parental	.07	.27***
<i>SUDSI</i>		
Fathers	.01	.11
Mothers	.04	.21***
Overall Parental	.04	.19***
Substance Use Duration		
Fathers	.01	.09
Mothers	.01	-.11
Poly-Substance Use Duration		
Fathers	.06	.24
Mothers	.01	.11
Number of SUD Parents	.05	.20*
Supervision	.02	-.14*

*p ≤ .05, **p ≤ .01, ***p ≤ .001

Results of the linear regression analyses predicting sons' *Substance Use Severity (SUSI)* are shown in Table 2.7. Parents' *SUSI* scores, number of SUD parents, and parental *Supervision* were significantly associated with *SUSI* scores in sons. Regarding the number of SUD parents, the addition of a second SUD parent from one SUD parent was significantly associated with *SUSI* scores in sons ($R^2 = .05$, $b = .20$, $p = .02$). However, the associations between parents' *Substance Use Duration* and *Polysubstance Use Duration*, and sons' *SUSI* scores were not significant. Sons' *Illicit SUSI* score (which omitted alcohol and tobacco use), was not associated with substance use duration in fathers (*Substance Use Duration*: $R^2 = .01$, $b = .10$, $p = .34$; *Polysubstance Use Duration*: $R^2 = .06$, $b = .24$, $p = .12$) and mothers (*Substance Use Duration*: $R^2 = .01$, $b = -.10$, $p = .47$; *Polysubstance Use Duration*: $R^2 = .02$, $b = .13$, $p = .61$). While the associations between *SUDSI* in mothers, as well as overall parental *SUDSI*, and *SUSI* in sons were statistically significant, this association between fathers' *SUDSI* and sons' *SUSI* approached significance ($R^2 = .01$, $b = .11$, $p = .06$). Additional regression analysis using a parental SUD severity factor score that was recalculated to include inhalant use disorder, which was previous shown to be endorsed by fathers who had the most severe SUD (Kirisci et al., 2006), showed a similar trend towards significant association with sons' *SUSI* ($R^2 = .01$, $b = .11$, $p = .06$). Additionally, parental *Supervision*, as an aspect of parental involvement affected by parents' substance use and SUD was also significantly associated with *SUSI* scores in sons. Among the parental substance involvement variables that significantly predicted sons' *SUSI*, mothers' and overall parental *SUSI* had the highest R^2 values. Furthermore, among the paternal substance use behavior variables tested, only fathers' *SUSI* significantly predicted sons' *SUSI*. After adjusting for the false discovery rate of multiple comparisons, the significant associations shown in Table 2.7 were retained.

In summary, sons' *SUSI* scores were consistently associated with *SUSI* scores in both parents. Mothers' and overall parental *SUSI* had the highest R^2 values in explaining sons' *SUSI*, while fathers' *SUSI* was the only paternal variable tested that was associated with sons' *SUSI*.

2.3.2 Parents' Substance Use Behavior Predicts Sons' SUD Severity

Results of the linear regression analyses predicting son's lifetime *SUD Severity (SUDSI)* are shown in Table 2.8. Parents' *SUSI*, parents' *SUDSI*, number of SUD parents, and parental *Supervision* were significantly associated with *SUDSI* scores in sons. Additionally, relative to having one SUD parent, having two SUD parents was significantly associated with greater *SUDSI* scores in sons ($R^2 = .03$, $b = .17$, $p = .01$). However, the associations between parents' *Substance Use Duration* and *Polysubstance Use Duration*, and sons' *SUDSI* were not significant. Sons' *Illicit SUDSI* also yielded non-significant associations with substance use durations in fathers (*Substance Use Duration*: $R^2 = .02$, $b = .15$, $p = .25$; *Polysubstance Use Duration*: $R^2 = .002$, $b = .04$, $p = .59$) and mothers (*Substance Use Duration*: $R^2 = .009$, $b = -.10$, $p = .35$; *Polysubstance Use Duration*: $R^2 = .002$, $b = -.05$, $p = .80$). The highest R^2 was obtained between *SUSI* in mothers and *SUDSI* in sons. Additionally, *SUSI* in fathers demonstrated a higher R^2 value in explaining sons' *SUDSI* ($R^2 = .021$) relative to *SUDSI* in fathers ($R^2 = .017$). After adjusting for false discovery rate, significant results shown in Table 2.8 were retained except the association between *Supervision* and sons' *SUDSI*, which trended toward significance ($p = .07$).

In summary, sons' *SUDSI* scores were most associated with *SUSI* scores in both parents. Mothers' *SUSI* had the highest R^2 value in explaining sons' *SUSI*, while fathers' *SUSI* had the highest R^2 value among paternal variables that were significantly associated with sons' *SUDSI*.

Table 2.8: Regression Analysis Predicting Sons' *SUDSI*

Predictors in Parents	<i>SUDSI</i> in Sons	
	R ²	b
<i>SUSI</i>		
Fathers	.02	.15**
Mothers	.06	.24***
Overall Parental	.03	.18***
<i>SUDSI</i>		
Fathers	.02	.13**
Mothers	.02	.15***
Overall Parental	.03	.17***
Substance Use Duration		
Fathers	.002	.05
Mothers	.01	-.11
Poly-Substance Use Duration		
Fathers	.03	.18
Mothers	.01	-.09
Number of SUD Parents	.03	.17*
Supervision	.01	-.09*
*p ≤ .05, **p ≤ .01, ***p ≤ .001		

2.3.3 Multiple Regression of Parents' Substance Use and SUD Severity

The results of the multiple regression analysis of parents' *SUSI* and *SUDSI* scores together in predicting sons' substance involvement are shown in Table 2.9. When parents' scores were entered together (fathers' *SUSI* + fathers' *SUDSI*; mothers' *SUSI* + mothers' *SUDSI*; overall parental *SUSI* + overall parental *SUDSI*), parents' *SUDSI* were not significantly associated with either sons' *SUSI* or sons' *SUDSI* scores. In contrast, the association between parents' *SUSI* and sons' *SUSI* scores remained significant. While mothers' *SUSI* , but not fathers' *SUSI*, was associated with sons' *SUDSI* scores, *Post hoc* analysis revealed that fathers' *SUDSI* did not

account for residual variance of sons' *SUDSI* ($R^2 < .001$, $b = .02$, $p = .64$) after it was regressed with fathers' *SUSI* scores. Additionally, the association between overall parental *SUSI* and sons' *SUDSI* approached significance ($b = .13$, $p = .07$). Relative to parents' *SUSI* scores, parents' *SUDSI* scores were not associated with sons' *SUSI* or *SUDSI* scores. Significant associations shown in Table 2.9 were retained after adjusting for false discovery rate of multiple comparisons.

Table 2.9: Multiple Regression Analysis Predicting Sons' *SUSI* and *SUDSI*

Predictors	Sons' <i>SUSI</i>		Sons' <i>SUDSI</i>	
	b	R	b	R
Fathers		.19		.15
<i>SUSI</i>	.24*		.11	
<i>SUDSI</i>	-.08		.05	
Mothers		.28		.26
<i>SUSI</i>	.22***		.23***	
<i>SUDSI</i>	.09		.01	
Overall Parental		.27		.19
<i>SUSI</i>	.29**		.13	
<i>SUDSI</i>	-.03		.07	
* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$				

Using structural equation modeling, similar results were found after accounting for the correlation between parents' *SUSI* and *SUDSI* scores in the same model. Parents' *SUSI* scores (fathers: $b = .25$, $p = .01$; mothers: $b = .22$, $p < .001$; overall parents: $b = .29$, $p = .001$), but not parents' *SUDSI* scores (fathers: $b = .08$, $p = .42$; mothers: $b = .09$, $p = .20$; overall parents: $b = .03$, $p = .76$), were associated with sons' *SUSI*. Additionally, parents' *SUDSI* scores (fathers: $b = .05$, $p = .48$; mothers: $b = .01$, $p = .80$; overall parents: $b = .07$, $p = .32$) were not associated with sons' *SUDSI* scores. Mothers' *SUSI* scores ($b = .23$, $p < .001$), but not fathers' ($b = .11$, $p = .13$), were associated with sons' *SUDSI* scores, while the association between overall parental *SUSI* and sons' *SUDSI* scores ($b = .13$, $p = .07$) trended toward significance. In sum, sons' scores were

most consistently associated with parents' *SUSI* scores, while fathers' *SUDSI* did not explain additional variance from beyond fathers' *SUSI*.

2.3.4 Mediation by Parents' Substance Use Severity

Figure 2.1a shows the results of testing the base model of the relationship between mothers' *SUDSI*, and sons' *SUSI* and *SUDSI*. Adequate model-data fit was obtained ($\chi^2 = 3.13$, $df = 1$, $p = .08$, $RMSEA = .08$, $CFI = .98$, $TLI = .94$). Figure 2.1b shows the results of testing the full model of the relationship between *SUSI* and *SUDSI* in mothers and sons. Adequate model-data fit was obtained ($\chi^2 = 5.74$, $df = 2$, $p = .06$, $RMSEA = .08$, $CFI = .98$, $TLI = .94$). *SUSI* in mothers showed a significant mediation effect on the association between mothers' *SUDSI* and sons' *SUSI* ($\beta = .13$, $z = 3.08$, $p = .002$). As observed in Figure 2.1a and b: 1) higher *SUDSI* in mothers predicted higher *SUSI* in sons; 2) higher *SUDSI* in mothers was associated with higher *SUSI* in mothers; and 3) higher *SUSI* in mothers predicted higher *SUSI* in sons. The association between mothers' *SUDSI* and sons' *SUSI* ($b = .22$, $p < .001$) reduced to non-significance upon adding the mothers' *SUSI* as a mediator ($b = .09$, $p = .20$). Furthermore, sons' *SUSI* was significantly associated with sons' *SUDSI* (Figure 2.1b) with the inclusion of mothers' *SUSI* and *SUDSI* in the model. Hence, *SUSI* in mothers mediated the association between mothers' *SUDSI* and sons' *SUSI* which, in turn, increased sons' *SUDSI*. Additionally, when mothers' *SUDSI* was removed from the mediation model shown in Figure 2.1b and tested again, adequate model-data fit was obtained ($\chi^2 = 5.74$, $df = 1$, $p = .02$, $RMSEA = .13$, $CFI = .96$, $TLI = .87$). Mothers' *SUSI* predicted sons' *SUSI* ($b = .28$, $p < .001$), which in turn predicted sons' *SUDSI* ($b = .62$, $p < .001$).

Figure 2.2a shows the results of testing the base model of the relationship between fathers' *SUDSI*, and sons' *SUSI* and *SUDSI*. Excellent model-data fit was obtained ($\chi^2 = 1.1$, df

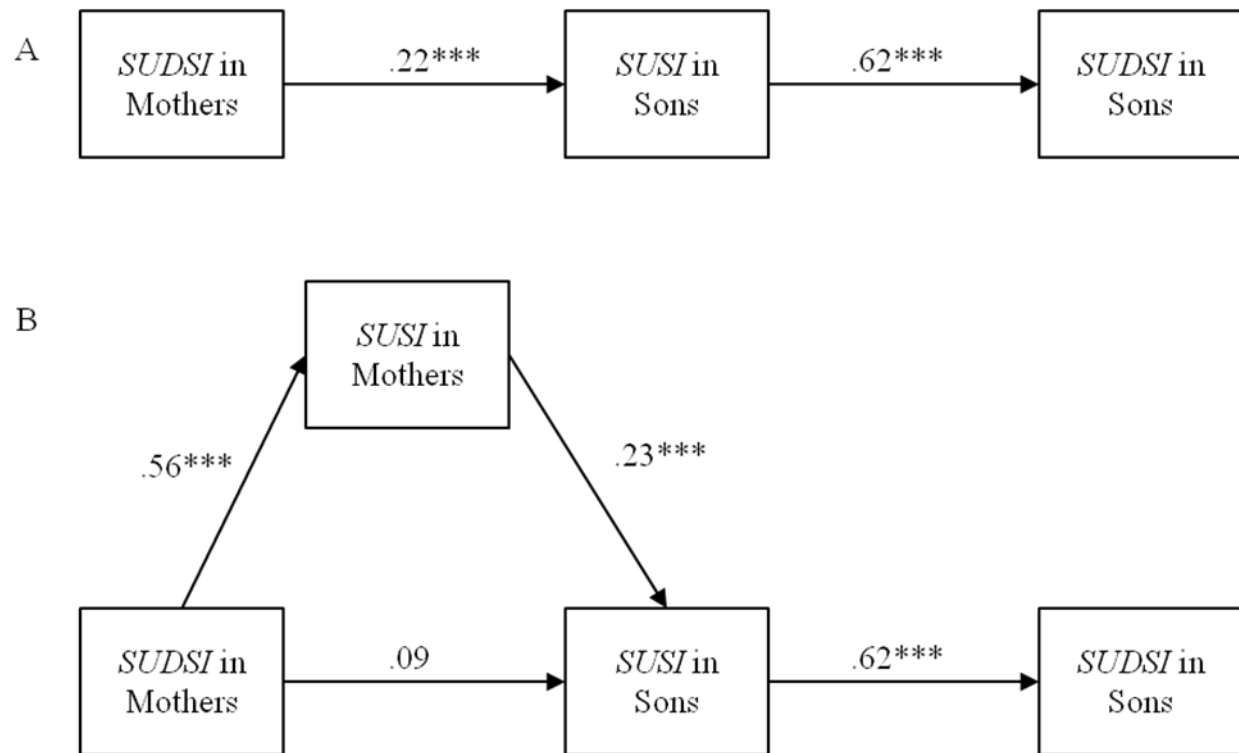


Figure 2.1: Mediation Effect of Mothers' *SUSI* in the Association between Mothers' *SUDSI* and Sons' *SUSI*. A. Base model of the association between *SUDSI* in mothers and *SUSI* in sons', leading to *SUDSI* in sons'. B. Full model of the mediation effect of *SUSI* in mothers. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

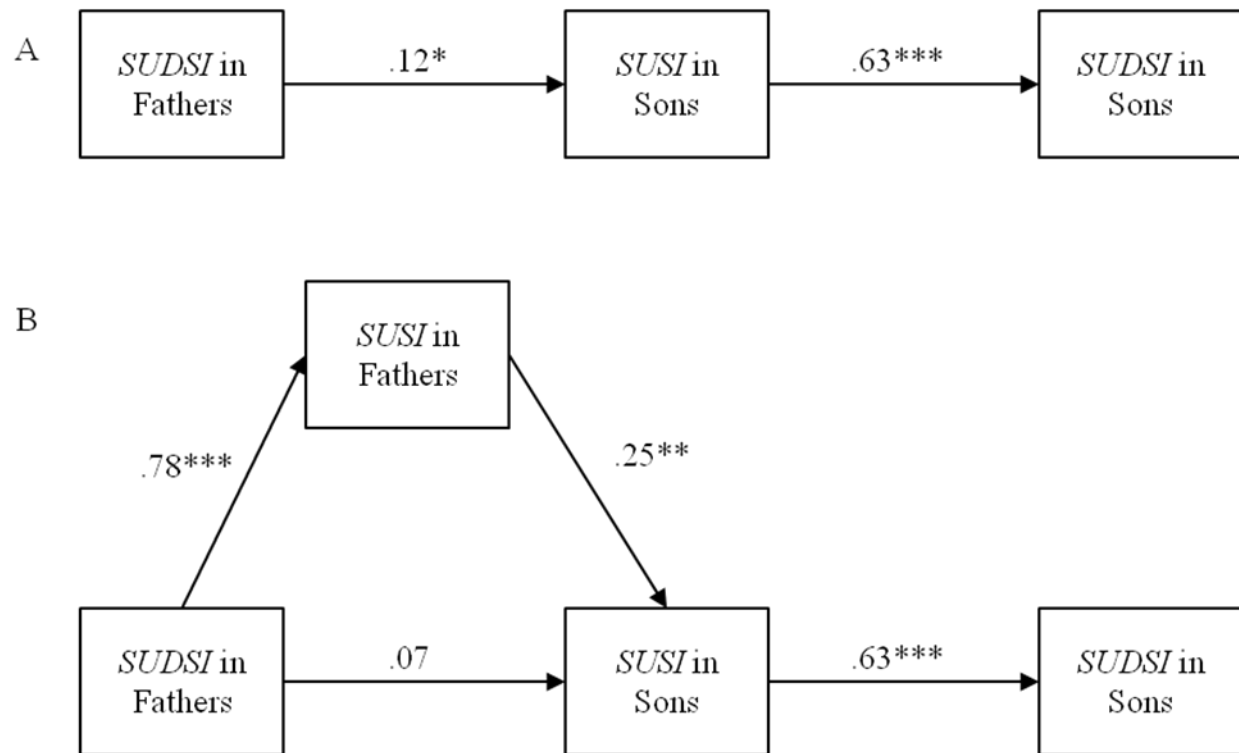


Figure 2.2: Mediation Effect of Fathers' *SUSI* in the Association between Fathers' *SUDSI* and Sons' *SUSI*. A. Base model of the association between *SUDSI* in fathers and *SUSI* in sons', leading to *SUDSI* in sons'. B. Full model of the mediation effect of *SUSI* in fathers. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

=1, $p = .3$, RMSEA = .02, CFI = .99, TLI = .99). Figure 2.2b shows the results of testing the full model of the relationship between *SUSI* and *SUDSI* in fathers and sons. Good model-data fit was obtained ($\chi^2 = 4.48$, $df = 2$, $p = .11$, RMSEA = .07, CFI = .99, TLI = .98). *SUSI* in fathers showed a significant mediation effect on the association between fathers' *SUDSI* and sons' *SUSI* ($\beta = .19$ $z = 2.86$, $p = .004$). It can be seen in Figure 2.2a and b that: 1) higher *SUDSI* in fathers predicted higher *SUSI* in sons; 2) higher *SUDSI* in fathers was associated with higher *SUSI* in fathers; and 3) higher *SUSI* in fathers predicted higher *SUSI* in sons. The association between fathers' *SUDSI* and sons' *SUSI* ($b = .11$, $p = .045$) reduced to non-significance upon adding the fathers' *SUSI* as a mediator ($b = .07$, $p = .37$). Furthermore, sons' *SUSI* was significantly associated with sons' *SUDSI* (Figure 2.2b) with the inclusion of fathers' *SUSI* and *SUDSI* in the model. Hence, *SUSI* in fathers mediated the association between fathers' *SUDSI* and sons' *SUSI* which, in turn, increased sons' *SUDSI*. Adequate model-data fit was obtained after fathers' *SUDSI* was removed from the model shown in Figure 2.2b and retested ($\chi^2 = 3.35$, $df = 1$, $p = .07$, RMSEA = .09, CFI = .98, TLI = .94). Fathers' *SUSI* predicted sons' *SUSI* ($b = .19$, $p = .002$), which in turn predicted sons' *SUDSI* ($b = .63$, $p < .001$).

Figure 2.3a shows the results of testing the base model of the relationship between overall parental *SUDSI* and sons' *SUSI* and *SUDSI*. Adequate model-data fit was obtained ($\chi^2 = 3.0$, $df = 1$, $p = .09$, RMSEA = .09, CFI = .98, TLI = .94). Figure 2.3b shows the results of testing the full model of the relationship between *SUSI* and *SUDSI* in overall parents and sons. Good model-data fit was obtained ($\chi^2 = 4.10$, $df = 2$, $p = .13$, RMSEA = .06, CFI = .99, TLI = .98). Overall parental *SUSI* showed a significant mediation effect on the association between overall parental *SUDSI* and sons' *SUSI* ($\beta = .23$ $z = 3.43$, $p = .001$). Figure 2.3a and b show, using overall parental *SUSI* and *SUDSI* scores, that: 1) higher parental *SUDSI* predicted higher *SUSI* in

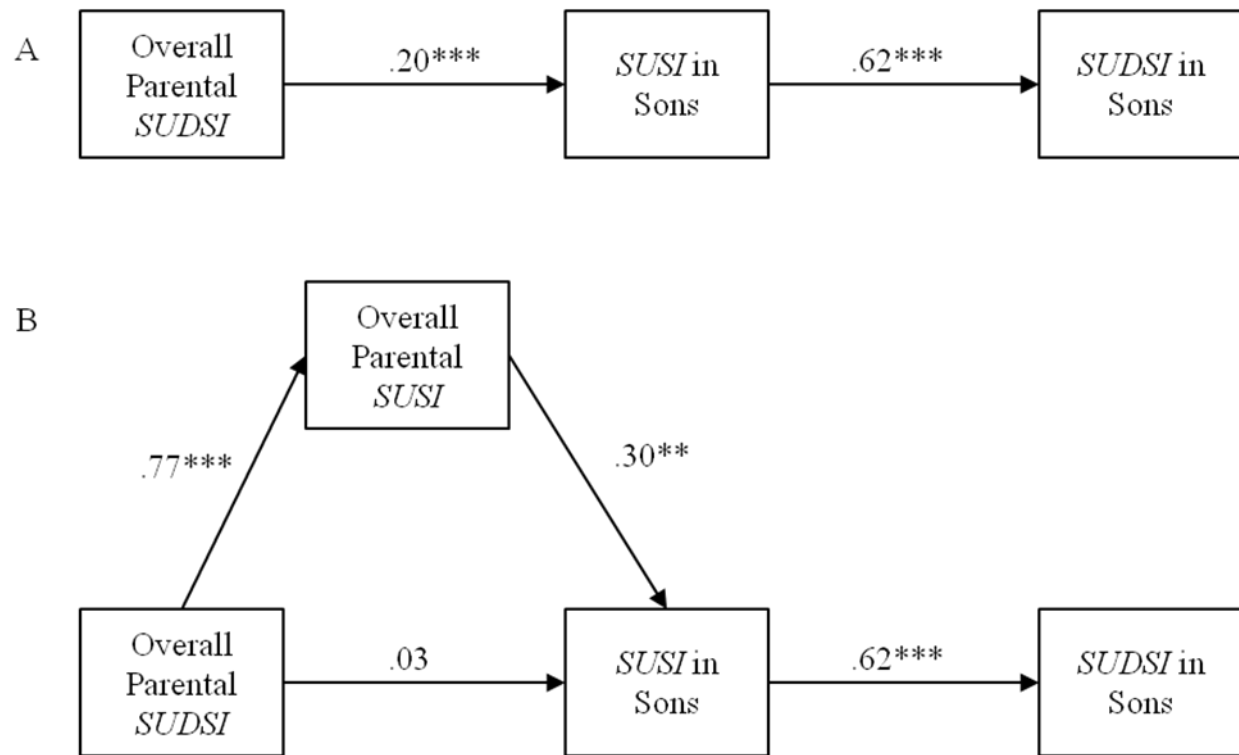


Figure 2.3: Mediation Effect of Overall Parental *SUSI* in the Association between Overall Parental *SUDSI* and Sons' *SUSI*. A. Base model of the association between overall parental *SUDSI* and *SUSI* in sons', leading to *SUDSI* in sons'. B. Full model of the mediation effect of overall parental *SUSI*. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$.

sons; 2) higher parental *SUDSI* was associated with higher parental *SUSI*; and 3) higher overall parental *SUSI* predicted higher *SUSI* in sons. The association between overall parental *SUDSI* and sons' *SUSI* ($b = .20$, $p = .001$) reduced to a non-significant level upon adding the overall parental *SUSI* as a mediator ($b = .03$, $p = .70$). Furthermore, sons' *SUSI* was significantly associated with sons' *SUDSI* (Figure 2.3b) with the inclusion of overall parental *SUSI* and *SUDSI* in the model. Hence, overall parental *SUSI* mediated the association between overall parental *SUDSI* and sons' *SUSI*, which in turn, increased sons' *SUDSI*. Adequate model-data fit was obtained after overall parental *SUDSI* was removed from the model shown in Figure 2.3b and retested ($\chi^2 = 3.5$, $df = 1$, $p = .06$, $RMSEA = .09$, $CFI = .98$, $TLI = .93$). Overall parental *SUSI* predicted sons' *SUSI* ($b = .27$, $p < .00$), which in turn predicted sons' *SUDSI* ($b = .62$, $p < .001$).

In summary, parents' (fathers, mothers, overall parents) *SUSI* statistically mediated the association between parents' *SUDSI* and sons' *SUSI*.

2.4 DISCUSSION

To briefly recapitulate, this study determined the parental substance use characteristics that best predict sons' substance use and SUD severity. The results revealed that parents' *SUSI* was the best predictor. Additionally, the regression analyses demonstrated that number of SUD parents and parental *Supervision* predicted substance use and SUD severity in sons. However, substance use duration in parents was not associated with sons' severity of substance use. *SUSI* in mothers statistically mediated the association between mothers' *SUDSI* and sons' *SUSI* while *SUSI* in fathers also mediated the fathers' *SUDSI* and sons' *SUSI* association. Furthermore, overall parental *SUSI* mediated the overall parental *SUDSI* and sons' *SUSI* association.

Parental substance use most consistently predicted sons' substance use with the highest R^2 values. Several theories have been posited to explain the mechanism by which substance use behavior, the act of using substances as well as drug seeking, in parents contributes to the substance use behavior in offspring. The results of the current study on the relationship between parents' and sons substance use are consistent with social learning theory (Petraitis et al., 1995; Akers, 1977; Bandura, 1986), which posits that children's drug taking behavior and favorable attitudes toward drugs, which contribute to the development of SUD, is influenced by norm violating beliefs and favorable attitudes towards drugs in parents (Bahr, Hoffmann, & Yang, 2005). Children's exposure to and involvement with substance using parents directly shapes their substance use through social reinforcement for antisocial and norm violating behavior, and expectations of positive social and physiological consequences of substance use (Akers, 1977; Akers & Cochran, 1985; Akers, Krohn, Lanza-Kaduce, & Radosevich, 1979; Krohn, Akers, Radosevich, & Lanza-Kaduce, 1982). These factors collectively increase substance use severity in offspring consistent with elevation in adolescent alcohol use and acquisition of favorable attitudes towards alcohol found in families with high alcohol use (Wills, Mariani, & Filer, 1996).

In linear regression analysis, parents' *SUDSI* scores had lower R^2 values, relative to parents' *SUSI* scores, in predicting sons' substance involvement. Additionally, in multiple regression analysis using parents' *SUSI* and *SUDSI* together in predicting sons' substance involvement, parents' *SUDSI* showed no significance. This may partly be due to the characteristics of the sample. While the *SUDSI* is a continuous scale, 51% of fathers and 76% of mothers in the current sample do not have an SUD diagnosis (SUD-), and only 1.8% of fathers and 2.1% of mothers have five or more SUD diagnoses. This places a large proportion of subjects into the lowest region of the *SUDSI* scale. Furthermore, use of different substance

categories are still exhibited by biological sons of SUD- fathers (substances used: mean = 2.95, sd = 2.16) and SUD- mothers (substances used: mean = 2.93, sd = 2.02). Hence, the parents' *SUDSI* accounts for a small proportion of the variance in sons' substance involvement. Furthermore, the *SUDSI* does not account for the use of substances in parents who did not reach criteria for clinical diagnosis of abuse or dependence, but nevertheless increase substance exposure and consequently involvement in offspring. To illustrate, SUD- fathers reported a mean of 3.14 (s.d. = 1.90) different substances used while fathers with an SUD+ diagnosis related to only one drug category reported a mean of 5.41 (s.d. = 2.31) different substances used. Additionally, SUD- mothers reported a mean of 3.16 (s.d. = 1.94) different substances used while mothers with an SUD+ diagnosis related to only one drug category reported a mean of 5.08 (s.d. = 2.17) different substances used. Nevertheless, the significant association between mothers' *SUDSI* and sons' *SUSI*, as well as the trend toward an association between fathers' *SUDSI* and sons' *SUSI* is consistent with previous reports. Kirisci et al. (2006) demonstrated, in a multiple regression with fathers' and mothers' SUD severity predicting number of substances used by sons, that fathers' SUD severity was not significant, suggesting a stronger relationship between mothers' and sons' substance involvement. The lack of significant association between fathers' *SUDSI* and sons' *SUSI* was not likely due to the omission of Inhalant Use Disorder and PCP Use Disorder to maintain scale uniformity. Similar regression results were obtained when Inhalant Use Disorder, which indicated the fathers with the most severe SUD (Kirisci et al., 2006), was combined into fathers' *SUDSI* scores ($R^2 = .01$, $b = .11$, $p = .06$). Hence, parents' substance use behavior, rather than SUD diagnoses explains more of the variance in sons' substance involvement.

Having two biological SUD parents was associated with greater substance use severity in sons, relative to having one biological SUD parent. A second clinically affected parent thus confers additional risk to offspring. This is consistent with literature suggesting that SUD in both parents, relative to one SUD parent, confers greater risk for early alcohol abuse as well as a faster onset rate of substance use problems (Westermeyer et al., 2007; Ridenour, Lanza, Donny, & Clark, 2006). Having two biological parents with SUD is a risk category that designated adolescents as part of high and intermediate general liability classifications for substance involvement and may identify groups requiring higher levels of interventions (Clark, Cornelius, Kirisci, & Tarter, 2005). Taken together with the high correlation between parents' *SUDSI* and *SUSI*, as well as the consistent ability of parents' *SUSI* to predict sons' substance involvement, having two biological parents with SUD may increase the level of exposure to substance use behavior in offspring. The addition of a second SUD parent presents two different sources from which substance use behavior may be demonstrated to and acquired by offspring, and consequently increases their risk for SUD.

It was not surprising that the analyses herein demonstrated that parents' substance use severity mediated the association between parents' SUD severity and sons' substance use severity, which predicted sons' SUD severity. SUD in parents, via their substance use liability, confers increased risk for substance use in offspring, leading to problematic consequences comprising the criteria for diagnosis of SUD. Greater substance involvement in parents, as a function of their SUD severity, increases offspring's proximity to and availability of abusable drugs, as well as exposure to positive attitudes toward drugs, which may be adopted (Bahr et al., 2005). While parental SUD contributes to a maladaptive developmental trajectory in offspring including substance involvement, presence of parental substance use behavior, as well as

associated positive attitudes towards and proximity to drugs, may present a more salient risk for initiation of substance use leading to problematic consequences in offspring. The mediation model in which substance use severity in parents proceeds from parental SUD severity may seem problematic as SUD does not occur without substance use. To account for the possible issues of collinearity between parental substance use and SUD severity that may confound the results, additional analyses were conducted in which parental *SUDSI* was removed from the mediation model and tested again. Results consistently showed that parents' *SUSI* contributed to sons' *SUSI*, which in turn led to sons' *SUDSI*. While a parental (*Poly*)*Substance Use Duration* may be more directly related to child's exposure to parent's substance use behavior, the lack of significant associations with sons' substance involvement precludes a mediation effect within the study sample.

The duration of parental substance use, and consequently length of exposure to the child, is less impactful on severity of substance use and SUD in offspring. This finding is consistent with the results in the few studies that assessed covariation between parental substance use duration within their children's lifetime and SUD etiology, which found a limited effect for duration (Biederman et al., 2000). Additional regression analyses between substance use duration and sons' *Illicit SUSI* and *Illicit SUDSI* (which omitted alcohol and tobacco involvement) similarly revealed no significant associations. The length of exposure to parental substance use behavior may not account for additional variation in offspring substance use beyond exposure itself, as well as the developmental period in which the exposure occurred (Biederman et al., 2000).

Additionally, sons who reported lower parental *Supervision* exhibited greater severity in substance use and SUD. During adolescence, the focus of parental supervision is on reducing the

likelihood of risky behaviors (Cicchetti & Toth, 1995). Supervision has been posited to allow parents to provide oversight for offspring, including peer relationships and activities that occur away from parents, as well as to constrain opportunities for risk behavior and compel prosocial behavior. Supervision is a primary dimension of parental involvement during adolescence (Jacob & Johnson, 1997). As such, a strong parental supervision leads to fewer substance use opportunities across various social contexts, thereby lowering severity of substance use and risk for SUD in offspring. Our findings are consistent with previous studies demonstrating an association between parental supervisory neglect and alcohol use as well as alcohol use disorder in adolescents (Clark et al., 2004; Clark & Winters, 2002; Clark, Thatcher et al., 2005). While a constellation of factors involved in parent-adolescent functioning uniquely contribute to the onset of substance use and SUD risk, parental supervision was suggested to have relatively limited effects on offspring's substance use (Bahr et al., 2005). The relatively low effects of parental supervision in the current study points to the need to identify other parenting factors influencing adolescent substance use and SUD severity.

These results must be considered in the context of study limitations. Non-significant findings involving parental substance use duration may be due to the methodology used to derive the variables. To compare between individuals, only parents with regular use (at least once per month, regardless of presence or absence of an SUD diagnosis) of illicit substances were included, which focused analyses on the higher end of the substance use frequency distribution. A portion of the variance contributed by parental substance use durations may have been overlooked when standardizing the variables across subjects. However, inclusion of subjects with lower use frequencies, as an example, would incur a problem when subjects with exceedingly different use frequencies (e.g., once per week vs. once per 3 months), but reported a

similar number of years of substance use, would receive similar duration scores. Hence, only subjects with regular use were included to maintain consistency in the sample. Additionally, parental *SUSI* and *SUDSI* were derived respectively from measures of lifetime substance use and SUD. In effect, the temporal order between the independent variable and the mediator, which would provide stronger causal inferences in the mediation analyses, was not established. However, the dependent variable, namely, sons' SUD severity does ensue after parental SUD and substance use. The *SUSI* was derived from items indicating presence or absence of use for a certain drug, while the *SUDSI* was derived from items indicating presence or absence of SUD related to a certain drug. While an instrument composed by summing these items may be considered a tally of SUDs, the current study derived the *SUSI* and *SUDSI* using factor analysis. Factor scores of these items, which were previously shown to correlate with scores derived from Item Response Theory, reflect the covariance between the different drug categories and the instruments were proposed to tap the common liability among them (Kirisici et al., 2002, 2006). Though rudimentary, the *SUSI* and *SUDSI* are robust indicators of substance involvement in parents and children on a continuous spectrum.

Further studies need to be directed at assessing the contribution of supervision relative to other aspects of parental involvement, particularly parent-child attachment. In addition, it is important for further studies to determine the relative contributions of parents' substance use severity and parenting indices to sons' substance use and SUD risk. Inasmuch as the substance use duration variable in this study spanned the period of 10-12 years, additional studies should focus on the association between parental substance use duration during specific phases of child development (i.e., infancy, middle childhood, late childhood).

In summary, this is the first study to examine the association of continuous indices of substance use and SUD severity between parents and children. The key finding, demonstrating that parents' substance use mediates the association between parents' SUD and sons' substance use leading to sons' SUD, indicates that parents' substance use is a behavioral link between parents' disorder and their children's substance use. This provides a potentially modifiable target for interventions aimed at reducing substance use and SUD outcomes in high risk youths. Additionally, this finding raises the question as to the factors that may be integral to this intergenerational pattern.

**3.0 CHAPTER 3: ATTACHMENT TO PARENTS INDEPENDENTLY PREDICTS
SONS' SUBSTANCE USE DISORDER SEVERITY**

3.1 INTRODUCTION

Parents' bonding and affection towards their child facilitate investment of resources and effort, especially necessary to infants and young children, and provide the foundation for internal representations of attachment relationships and perceived security in the child. Parents lacking a strong emotional bond with their child are often poorly involved in the care and well-being of their child, which may manifest as maltreatment. Child's experience of maltreatment as well as ineffective parenting practices disrupts formation of strong attachment bonds to parents. In addition, deficient parenting skills amplify the child's risk for initiating substance use and subsequent SUD. As such, the common thread linking ineffective parenting practices and substance involvement may be a weak emotional bond between parents and child. Indeed, poor parent-child attachment increases child's risk for substance use and SUD (Zhai et al., 2014).

There is limited understanding of the role of attachment to parents in child's etiology of SUD relative to the effects of parents' substance involvement. The purpose of this section is to demonstrate the independent contribution of child's attachment to parents on sons' substance involvement, as well as phases of substance use (use initiation, regular use, problem use) beyond the effects of parental substance involvement. Furthermore, the effects of the attachment construct are distinguished from the parenting practice of supervision with respect to sons' substance involvement. These analyses are particularly meaningful and informative for prevention research as it identifies an independent factor construct that is part of the etiological pathway of SUD for targeted intervention even in the presence of parental substance involvement.

3.2 METHODS

3.2.1 Participants

The participants were 499 families in which the father had a biological son enrolled in a longitudinal investigation directed at elucidating the etiology of SUD, and a spouse who was the biological mother of the child willing to participate in the longitudinal study. The recruitment methods and demographic characteristics of the participants are described in [Chapter 2](#).

3.2.2 Instrumentation

3.2.2.1 Substance Use Severity Index (SUSI): The *SUSI* (Kirisci et al., 2002) was employed to document severity of substances used in sons, fathers, mothers, and overall parents. The formulation of the *SUSI* was described in [Chapter 2](#).

3.2.2.2 Substance Use Disorder Severity Index (SUDSI): The *SUDSI* (Kirisci et al., 2006) was used to quantify severity of SUD in sons taking into account the manifold permutations of co-occurring disorders. Formulation of the *SUDSI* was described in [Chapter 2](#).

3.2.2.3 Youth Attachment to Parents Scale (YAPS): The *YAPS* was used to measure the 10-12 year old son's emotional bond and relationship with each biological parent. Derivation and psychometric properties of the *YAPS* in youths at ages 10-14 was described previously (Zhai et al., 2014). Briefly, initial item selection was determined by their face validity that denotes features of attachment. The items aligned with the *PIML* and *IPPA* scales developed to measure

attachment in children and older adolescents (Cook et al., 1995; Ridenour, Greenberg et al., 2006; Armsden & Greenberg, 1987). Items were selected from the *Revised Parent Adolescent Communication Form* (Stouthamer-Loeber, Loeber, Wei, Farrington, & Wikstrom, 2002), *Child's Relationship with Caretaker Scale* (Stouthamer-Loeber et al., 2002), *Supervision/Involvement Scale* (Jacob et al., 2000), *Children's Report on Parental Behavior Inventory* (Schaefer, 1965), and the Dyadic Scale in the *Family Assessment Measure* (Skinner, Steinhauer, & Santa-Barbara, 1983). To refine the item selection and obtain the final items, exploratory factor analysis was conducted using the maximum likelihood estimation method with varimax rotation. The criteria used to determine item retention of first-order factors included scree plots, item loadings greater than .4 (the more conservative threshold), proportion of covariance accounted for by each factor, and eigenvalue-greater-than-one rule. Eigenvalues on the scales measuring attachment to fathers are 1 = 8.89, 2 = 2.18, 3 = 1.46, 4 = 1.21, 5 = 1.09, +5 < 1. For mothers, they are 1 = 7.81, 2 = 2.29, 3 = 1.65, 4 = 1.19, 5 = 1.08, +5 < 1. Scree plots of the eigenvalues revealed a three factor solution accounting for 40.4% and 38% of the inter-item variance in fathers and mothers respectively. Each item loads on only one factor that corresponds with the *Communication*, *Alienation*, and *Trust* constructs. The three first-order factors are significantly inter-correlated: *Communication* and *Alienation* (father $r = .62$, $p < .001$; mother $r = .52$, $p < .001$), *Communication* and *Trust* (father $r = .53$, $p < .001$; mother $r = .46$, $p < .001$), and *Alienation* and *Trust* (father $r = .54$, $p < .001$; mother $r = .42$, $p < .001$). These strong correlations imply the presence of a second order factor.

Accordingly, exploratory factor analysis was conducted on the first-order factors (each summed scores of their respective items) to test model fit for a second order factor. While confirmatory factor analysis is typically used to test fit of a second order factor, it would impose

a perfect fit because the implied model is considered "just identified" with having only three first-order factors (Chen, Sousa, & West, 2005). In addition, a factor difference ratio $[(\text{eigenvalue } 1) - (\text{eigenvalue } 2) / (\text{eigenvalue } 2) - (\text{eigenvalue } 3)]$ of three or greater was required to accept a model consisting of one single second order factor (Hattie, 1985).

The primary scales (*Communication*, *Alienation*, and *Trust*) load onto a second order factor accounting for 70.7% of variance in fathers and 64.6% of variance in mothers. In addition, Cronbach's alpha is .91 and .90 for fathers and mothers. Moreover, the factor difference ratio index values (father = 15.21; mother = 10.85) exceed the criterion to accept a higher order factor (Hattie, 1985). In aggregate, these findings indicate that a second order factor of attachment to each parent accounts for the variance on the primary scales measuring *Communication*, *Alienation*, and *Trust*. Accordingly, the second order attachment factor score was used in the analyses.

Furthermore, because *YAPS* scores in fathers and mothers are strongly correlated (Pearson $r = .79$, $p < .001$), their scores were summed to produce an overall *YAPS* (mean = 45.3, $sd = 7.99$). The items comprising the *YAPS*, and their factor loadings are presented in the [Appendix](#) (adapted from Zhai et al., 2014).

3.2.2.4 Supervision: Parents' awareness of children's whereabouts, activities, and peers was quantified using the *Supervision* scale (Clark et al., 2004, 2008; Clark, Thatcher et al., 2005). The method of developing the *Supervision* scale was described in [Chapter 2](#).

3.2.2.5 Lifetime Drug and Alcohol Use History: Age of substance involvement onset assessed using an adaptation of the *Lifetime Alcohol Use History Chart* (Skinner, 1982; Skinner & Sheu,

1982), was described previously (Ridenour, Lanza et al., 2006; Clark et al., 2001). Briefly, during baseline and follow-ups assessments, sons were asked whether they used abusable substances from a list of 40 compounds, including alcohol, cannabis, cocaine, and opiates. For each substance used, sons were instructed to estimate the date of onset to within a month for initiation, and regular use (at least once per month). As alcohol consumption in amounts less than one standard drink (e.g., "a sip") was demonstrated to neither consistently indicate problem use nor predict substance related problems (Clark, Kirisci, & Moss, 1998), alcohol initiation was measured as the first time consumption of one standard drink (one ounce) of alcohol. Initiation of other substances was the first consumption of any amount. The percentage of the sample describing initiation and regular use of each drug and the mean ages of onset are shown in Table 3.1. As there were too few cocaine and opiate users for statistical analysis, only the two most common legal (alcohol) and illegal (cannabis) drugs used were studied.

Table 3.1: Phases in Sons' Substance Use

Substances	Initiation	Regular Use	Use Problem
Alcohol			
n (%)	343 (69.57%)	266 (53.96%)	168 (34.08%)
mean age (sd)	14.44 (2.87)	16.08 (2.37)	16.71 (2.40)
Cannabis			
n (%)	251 (50.91%)	175 (35.50%)	136 (27.59%)
mean age (sd)	15.30 (2.01)	15.42 (2.09)	16.13 (2.33)
Cocaine			
n (%)	38 (7.70%)	19 (3.85%)	16 (3.25%)
mean age (sd)	18.97 (2.52)	19.70(2.48)	19.45 (2.95)
Opiate			
n (%)	36 (7.30%)	21 (4.26%)	15 (3.04%)
mean age (sd)	17.65 (2.31)	18.48 (2.41)	17.73 (1.96)

3.2.2.6 Kiddie-Schedule for Affective Disorders and Schizophrenia (K-SADS): During baseline, age 12-14, and age 16 assessments, sons were examined using the *K-SADS* (Clark et al., 2001) on whether they experienced any problems (a DSM-III-R abuse or dependence criterion) consequent to use of substances including alcohol, cannabis, cocaine, and opiates. For each substance, sons were instructed to estimate the date they first experienced problems to within a month. The *KSADS* has reported reliability and validity for assessing symptomatology and onset of substance related problems in adolescents (Chambers et al., 1985). The DSM-III-R taxonomy (American Psychiatric Association, 1987) for substance related problems was used because it was the last edition at the time this study was initiated. The percentage of the sample describing first problems related to use of each drug and the mean ages of onset are shown in Table 3.1

3.2.2.7 Structured Clinical Interview for Diagnosis (SCID): During follow-up assessments after achieving 18 years of age, sons were assessed using the *SCID* (Spitzer et al., 1990) on whether they experienced any problems (a DSM-III-R abuse or dependence criterion) consequent to use of substances including alcohol, cannabis, cocaine, and opiates. For each substance, sons were instructed to estimate the date they first experienced problems to within a month. The *SCID* has been reported to have good to excellent reliability and validity for assessing symptomatology and of onset of substance related problems (Bailey, Martin, Lynch, & Pollock, 2000; Martin, Pollock, Bukstein, & Lynch, 2000). The percentage of the sample describing first problems related to use of each drug and the mean ages of onset are shown in Table 3.1

3.2.3 Statistical Analyses

Analyses using variables related to both parents (overall parental *SUSI* and overall *YAPS*) included only families in which both the biological father and mother resided with their son. To determine the relationship between *YAPS* scores and sons' *SUSI* and *SUDSI* scores, linear regression was performed in separate analyses using the *YAPS* scores for fathers as the independent variable and the sons' *SUSI* and *SUDSI* scores as the dependent variables. The analyses were repeated using *YAPS* scores for mothers and overall *YAPS* scores as independent variables.

The relative effects of *YAPS* and parental *SUSI* scores on sons' *SUSI* and *SUDSI* scores were examined using multiple regression. *YAPS* and *SUSI* scores for fathers were entered together as independent variables. In separate analyses, the sons' *SUSI* and *SUDSI* scores were the dependent variables. This procedure was repeated with the independent variables; *YAPS* and *SUSI* scores for mothers, as well as overall *YAPS* and overall parental *SUSI* scores. The association between parental *Supervision* and *YAPS* was examined by Pearson correlation. Additionally, the relative effects of the parenting variables, *Supervision* and *YAPS* scores, on sons' *SUSI* and *SUDSI* scores were examined using multiple regression. *Supervision* and *YAPS* for fathers were entered together as independent variables. In separate analyses, sons' *SUSI* and *SUDSI* scores were the dependent variables. This procedure was repeated with *Supervision* and *YAPS* for mothers in addition to *Supervision* and overall *YAPS* as the independent variables.

Regarding our corollary aim, the relative effects of parental *Supervision* and parents' *SUSI* on sons' *SUSI* and *SUDSI* were also examined using multiple regression. *Supervision* and fathers' *SUSI* scores were entered together as independent variables. In separate analyses, the sons' *SUSI* and *SUDSI* scores were the dependent variables. This procedure was repeated for the

independent variables; *Supervision* and mothers' *SUSI* scores, as well as *Supervision* and overall parental *SUSI* scores. To keep experiment wise Type I error rate of regression analyses at .05, false discovery rate was used to adjust the alpha for 24 total comparisons using data on fathers, mothers and parents combined.

Lastly, Cox regression analysis was performed to determine the effect of *YAPS* on the rate of substance initiation and problems. Analyses pertaining to cannabis and alcohol were conducted separately. *YAPS* for fathers, mothers, and overall parents scores were separately used as the independent variable. Sons' age of onset and event occurrence for substance initiation, first regular use, and first problems consequent to substance use were used as the dependent variable in separate analyses. Cox regression analyses of substance use onset were repeated after controlling for parents' *SUSI* scores.

3.3 RESULTS

3.3.1 Association between Attachment and Sons' Substance Use and SUD

YAPS scores for fathers ($R^2 = .04$, $b = -.19$, $p = .003$) and mothers ($R^2 = .03$, $b = -.18$, $p = .003$), as well as overall *YAPS* scores ($R^2 = .04$, $b = -.21$, $p = .001$) were associated with sons' *SUSI* scores. Additionally, *YAPS* scores for fathers ($R^2 = .02$, $b = -.14$, $p = .006$) and mothers ($R^2 = .02$, $b = -.14$, $p = .006$), as well as overall *YAPS* scores ($R^2 = .02$, $b = -.15$, $p = .004$) were associated with sons' *SUDSI* scores.

Results of the multiple regression analyses using *YAPS* and parental *SUSI* scores indicate that together they predict sons' *SUSI* scores as shown in Table 3.2. *YAPS* and parental *SUSI*

scores conjointly in fathers, mothers, as well as overall parents, were associated with sons' *SUSI* scores. Results of the multiple regression analyses using *YAPS* and parental *SUSI* scores together to predict sons' *SUDSI* are also shown in Table 3.2. Similarly, *YAPS* and parental *SUSI* scores conjointly in fathers, mothers, as well as overall parents, were associated with sons' *SUDSI* scores. The R^2 of *YAPS* and parental *SUSI* scores regressed conjointly against sons' *SUSI* scores were relatively greater than the R^2 of *YAPS* (fathers' *SUSI* $R^2 = .04$, mothers' *SUSI* $R^2 = .03$, overall parental *SUSI* $R^2 = .04$) and parental *SUSI* scores (Table 2.6: fathers' *SUSI* $R^2 = .03$, mothers' *SUSI* $R^2 = .07$, overall parental *SUSI* $R^2 = .07$) regressed individually. Similarly, the R^2 of *YAPS* and parental *SUSI* scores regressed conjointly against sons' *SUDSI* scores were relatively greater than the R^2 of *YAPS* (fathers' *SUSI* $R^2 = .04$, mothers' *SUSI* $R^2 = .03$, overall parental *SUSI* $R^2 = .04$) and parental *SUSI* scores (Table 2.6: fathers' *SUSI* $R^2 = .02$, mothers' *SUSI* $R^2 = .02$, overall parental *SUSI* $R^2 = .02$) regressed individually. After adjusting for false discovery rate, all significant results shown in Table 3.2 were retained exception the association between fathers' *SUSI* and sons' *SUDSI*, which trended towards significance ($p = .07$).

Table 3.2: Multiple Regression of Parental *SUSI* and *YAPS* in Sons' Substance Involvement

Predictors	Sons' <i>SUSI</i>		Sons' <i>SUDSI</i>	
	b	R	b	R
Fathers		.25		.17
<i>SUSI</i>	.16**		.10*	
<i>YAPS</i>	-.17**		-.13*	
Mothers		.33		.25
<i>SUSI</i>	.27***		.21***	
<i>YAPS</i>	-.17**		-.12**	
Overall Parental		.31		.21
<i>SUSI</i>	.24***		.15**	
<i>YAPS</i>	-.18**		-.13**	
R of predictors regressed conjointly against sons' <i>SUSI</i> or <i>SUDSI</i> . * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$				

YAPS scores were correlated with *Supervision* scores (fathers: $r = .29$, $p < .001$; mothers: $r = .26$, $p < .001$; overall parents: $r = .29$, $p < .001$). Results of multiple regression analyses using *Supervision* and *YAPS* scores regressed together to predict sons' *SUSI* scores are shown in Table 3.3. Of the two predictors regressed together, *YAPS* scores for fathers, mothers, and overall parents, but not *Supervision*, were associated with sons' *SUSI* scores. As also shown in Table 3.3, the results of multiple regression analyses using *Supervision* and *YAPS* scores regressed together to predict sons' *SUDSI* indicated that only *YAPS* scores for parents (fathers, mother, and overall parents) were associated with sons' *SUDSI* scores. In general, when *YAPS* and *Supervision* were entered together as predictor variables, only *YAPS* was associated with sons' *SUSI* and *SUDSI*. All significant associations shown in Table 3.3 were retained after adjusting for false discovery rate.

Table 3.3: Multiple Regression of *YAPS* and *Supervision* in Sons' Substance Involvement

Predictors	Sons' <i>SUSI</i>		Sons' <i>SUDSI</i>	
	b	R	b	R
Fathers				
<i>YAPS</i>	-.17**	.20	-.12*	.15
<i>Supervision</i>	-.07		-.06	
Mothers				
<i>YAPS</i>	-.18**	.22	-.12*	.15
<i>Supervision</i>	-.08		-.07	
Overall Parental				
<i>YAPS</i>	-.19**	.22	-.13*	.16
<i>Supervision</i>	-.07		-.06	

R of predictors regressed conjointly against sons' *SUSI* or *SUDSI*. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

In summary, the *YAPS* independently predicts the sons' *SUSI* and *SUDSI* in addition to parents' *SUSI*. *YAPS* and parents' *SUSI* conjointly account for more variance in sons' *SUSI* and

SUDSI than either predictor alone. However, *Supervision* does not independently predict sons' *SUSI* and *SUDSI* in addition to the *YAPS*.

3.3.2 Association between Supervision and Sons' Substance Use and SUD Severity

Results of multiple regression analyses using *Supervision* and parents' *SUSI* scores regressed together to predict sons' *SUSI* scores are shown in Table 3.4. *Supervision* conjointly with fathers' *SUSI*, mother's *SUSI*, and overall parental *SUSI* were associated with sons' *SUSI* scores. As also shown in Table 3.4, the results of multiple regression analyses using *Supervision* and parents' *SUSI* scores regressed together to predict sons' *SUDSI* indicated that only parental *SUSI* scores (fathers, mother, and overall parents) were associated with sons' *SUDSI* scores. In general, when *Supervision* and parental *SUSI* scores were entered together as predictor variables, both were associated with sons' *SUSI* scores, but only parental *SUSI* scores were associated with sons' *SUDSI* scores. Taken together, *Supervision* independently predicts sons' *SUSI* in addition to parents' *SUSI*, but not sons' *SUDSI* scores. After adjusting for false discovery rate, all significant associations shown in Table 3.4 were retained.

Table 3.4: Multiple Regression of Parental *SUSI* and *Supervision* in Sons' Substance Involvement

Predictors	Sons' <i>SUSI</i>		Sons' <i>SUDSI</i>	
	b	R	b	R
Fathers				
<i>SUSI</i>	.19**	.24	.14**	.17
<i>Supervision</i>	-.14*		-.09	
Mothers				
<i>SUSI</i>	.28***	.31	.16***	.19
<i>Supervision</i>	-.14*		-.09	
Overall Parental				
<i>SUSI</i>	.26***	.30	.18***	.20
<i>Supervision</i>	-.14*		-.09	
R of predictors regressed conjointly against sons' <i>SUSI</i> or <i>SUDSI</i> . * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$				

3.3.3 Cox Regression Analysis of YAPS and Substance Use Onset

The hazard ratios from Cox regression analysis of *YAPS* in predicting sons' onset rates of alcohol use initiation, first regular alcohol use, and first problems consequent to alcohol use are presented in Table 3.5. Only *YAPS* for mothers and overall *YAPS* scores were associated with the rate of alcohol use initiation. However, the associations were no longer significant after controlling for mothers' as well as overall parental *SUSI* scores. Additionally, while only *YAPS* for fathers was associated with the rate of first regular alcohol use and first problems consequent to alcohol use, the associations were not significant after controlling for fathers' *SUSI*.

Table 3.5: Cox Regression Analysis of Alcohol Use Onset in Sons

Predictors	Alcohol Initiation		Alcohol First Regular Use		Alcohol First Problem	
	Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI
<i>YAPS</i>						
Father	.977	.952-1.002	.966*	.938-.995	.963*	.928-.998
Mother	.972*	.945-1.001	.973	.943-1.004	.968	.931-1.006
Overall Parental	.986*	.971-1.000	0.984	.968-1.001	.981	.961-1.002
<i>YAPS</i> Controlling for Parents' <i>SUSI</i>						
Father	.979	.954-1.005	.968	.939-.997	.968	.932-1.006
Mother	.976	.948-1.005	.976	.946-1.007	.976	.940-1.015
Overall Parental	.988	.973-1.003	.986	.970-1.003	.987	.966-1.009

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

The hazard ratios from Cox regression analysis of *YAPS* in predicting sons' onset rates of cannabis use initiation, first regular cannabis use, and first problems consequent to cannabis use are presented in Table 3.6. *YAPS* scores for fathers and mothers, as well as overall *YAPS* scores were each associated with sons' rate of cannabis use initiation, first regular cannabis use, and first problems consequent to cannabis use. These association remained significant after controlling for

parent's *SUSI*, with the exception of the association between *YAPS* for mothers and sons' onset rate of first cannabis use problems, which only approached significance ($p = .06$) after controlling for mothers' *SUSI*.

Table 3.6: Cox Regression Analysis of Cannabis Use Onset in Sons

Predictors	Cannabis Initiation		Cannabis First Regular Use		Cannabis First Problem	
	Hazard Ratio	95% CI	Hazard Ratio	95% CI	Hazard Ratio	95% CI
<i>YAPS</i>						
Father	.951***	.922-.980	0.935***	.903-.968	.932***	.898-.967
Mother	.94***	.909-.973	0.944**	.908-.981	.952*	.912-.994
Overall Parental	.969***	.952-.987	0.960***	.940-.980	.96***	.938-.982
<i>YAPS</i> Controlled for Parents' <i>SUSI</i>						
Father	.955**	.925-.985	0.938***	.905-.971	.936***	.902-.972
Mother	.948**	.916-.981	0.952**	.916-.989	.961	.922-1.002
Overall Parental	.973**	.956-.991	0.964***	.943-.985	.965**	.942-.988

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

In summary, the *YAPS* predicted the onset rate of sons' cannabis use initiation, first regular cannabis use, and first cannabis use problems, but not alcohol use and problems with alcohol.

3.4 DISCUSSION

To briefly recapitulate, fathers', mothers', and overall parental *YAPS* scores predicted *SUSI* and *SUDSI* scores in sons. Parents' *SUSI* and *YAPS* scores both contribute to explaining the variance in sons' *SUSI* and *SUDSI* scores. However, *Supervision* does not account for additional variance in sons' *SUSI* and *SUDSI* scores explained by *YAPS* scores. While parents' *SUSI* and *Supervision*

scores independently account for variance in sons' *SUSI* scores, *Supervision* did not account for additional variance in sons' *SUDSI* scores. Finally, *YAPS* scores were associated with sons' onset rate of cannabis use initiation, regular cannabis use, and problems due to cannabis use even after controlling for parents' *SUSI* scores.

Whereas previous studies have shown that parenting style (Hoeve, Dubas, Gerris, van der Laan, & Smeenk, 2011) and parenting skills (Bailey et al., 2013; Henry, Tolan, & Gorman-Smith, 2001) are related to the child's propensity to engage in socially non-normative and illegal behaviors including substance use (Moore et al., 2010; Ridenour et al., 2009; Castro, Brook, Brook, & Rubenstone, 2006; Hotton & Haans, 2004), the present study demonstrates the importance of parent-child affective bonding indicated by the association of attachment to parents and child's substance use and SUD. This finding is consistent with previous studies on the *YAPS*, which showed that parent-child attachment correlated with child's cannabis and alcohol use frequencies at age 19, as well as predicted SUD at age 22 (Zhai et al., 2014). Suboptimal parent-child attachment hampers motivation to invest in the child's well-being, including consistent and effective supervision and protection (Hahn-Holbrook, Holbrook, & Haselton, 2011). Where low attachment is the outcome of parental disengagement, the child's risk for antisocial behavior, which often occurs in conjunction with substance abuse, is greatly increased (Patock-Peckham & Morgan-Lopez, 2010). The results obtained in this study indicate that low attachment along with other parenting factors including parenting skills and discipline practices also contribute to son's substance involvement. In addition, family-based prevention programs should inculcate a positive father-child and mother-child relationship.

This is one of the first studies that directly examined the relationship between parental substance use severity and attachment to parents during early adolescence on the offspring's

substance use and SUD severity using a prospective design. While parental substance involvement may be detrimental to parent-child attachment through suboptimal parenting behaviors and skills (Suchman, Mayes, Conti, Slade, & Rounsaville 2004; Mayes & Truman, 2002; Levy, Truman, & Mayes, 2001; Murphy & Rosenbaum, 1999) leading to child's substance involvement, the current results suggest that the effects of poor attachment on child substance use and SUD are not solely a consequence of parental substance involvement. Indeed, previous studies have shown that poor attachment to parents increases child's risk for substance use in a community sample (Bahr et al., 2005). It must be noted that in the prospective design of the current study, up to 14 years separate assessments of the sons' attachment to parents at baseline (age 10-12) and the sons' substance involvement in adulthood (age 22). A range of intervening neuropsychological and social factors during adolescence also contribute to SUD risk as well as influence the impact of attachment (Zhai et al., 2014). Nevertheless, the limited significant association between attachment to parents and substance involvement in sons' emphasizes the critical contribution of parent-child bonding on child's development of SUD. Hence, poor attachment to parents additionally contributes to the risk of SUD in youths, beyond the effects of parents' substance use.

Furthermore, these analyses extend results demonstrating that parental supervision is associated with sons' substance use severity by showing that while supervision contributed to explaining unique variance to sons' substance use severity, it did not contribute to explaining the variance beyond attachment to parents. These findings are somewhat consistent with previous studies which indicated that attachment to parents explained unique variance in indicators of psychological adjustment, including oppositional-defiant disorder, independent of alternative measures of the parent-child relationship (Scott et al., 2011). It has been suggested that the types

of parenting behaviors that increase supervision similarly facilitate secure parent-child attachment. Poor parent-child bonding and supervision are frequently co-occurring outcomes of child maltreatment and poor parenting behaviors (Tarter, 2002). Jang & Smith (1997) demonstrated that while no time lagged causal impact linked parental supervision and attachment (termed affective ties), the two variables were closely correlated ($b = .36$ to $.51$). Indeed, attachment and supervision are commonly treated as co-occurring family processes that predict substance use (Eitle, 2005; Oxford, Harachi, Catalano, & Abbot, 2001). However, the attachment construct may be a broader indicator of risk characteristics of substance use. While supervision had a limited scope pertaining to the parents' awareness of offspring's activities and relationships, attachment accounts for shared variance in three different domains (*Communication, Alienation, and Trust*), which may capture a broad range of maladaptive parenting behaviors and parent-child interactions. Hence, attachment to parents may be a more comprehensive indicator of parent-child relationship quality in predicting SUD risk.

The Child Assessment of Parental Involvement and Behavior (*CAPIB*) scale was previously developed at CEDAR to evaluate parenting style based on the sons' evaluation of parent's behavior toward him, as well as parental emotional distance and involvement. While it contained items similar to the *YAPS*, parenting scores on *CAPIB* in both fathers and mothers were not shown to be correlated with sons' SUD risk (Vanyukov et al., 2007). This discrepancy with the current study results may partly be explained by several factors. The current study had a larger sample ($n = 499$ total families) of which 309 returned for the final assessment compared to 148 male participants in the study by Vanyukov and colleagues (2007). The larger sample size provided greater statistical power to detect the effects of attachment to parents on sons' substance use. Furthermore, the current study assessed the final substance involvement outcomes in sons at

age 22, which contained a higher rate of SUD compared to age 18-19 outcomes in the previous study. Hence, while our findings showing a significant association between child's attachment and substance involvement are not consistent with a previous study conducted on this sample, the discrepancy may be attributed to the size of the samples in the two projects.

After controlling for parents' substance use severity in the Cox regression analyses, attachment to parents remained significantly associated with the onset of cannabis (the most commonly used illicit drug) initiation, regular use, and time to first problem with use. Previous studies have similarly demonstrated an association between poor parent-child bonding and early substance initiation (Brook, Kessler, & Cohen, 1999; Icick et al., 2013). Prosocial family processes (monitoring and attachment) are negatively associated with substance use initiation (Oxford et al., 2001). Similarly, poor relationship with mothers was associated with cannabis use initiation, while poor relationship with fathers predicts cannabis abuse in follow-ups (von Sydow, Lieb, Pfister, Hofler, & Wittchen, 2002). Secure attachment to parents may reduce the onset of regular (at least once per month) cannabis use and problems related to use found in this study by providing protection and security against stress; these latter factors may contribute to a steeper escalation of substance use following first use (Hoffmann, Cerbone, & Su, 2000; Nolte et al., 2011). In a similar thread, poor parent-child bonding contributes to earlier disengagement from parents' sphere of influence, which leads to greater opportunities for norm-violating behavior that increase the risk for substance use at an early age (Tarter, 2002).

In contrast, attachment to parents was not associated with the onset of alcohol use and problems due to alcohol after controlling for parental substance use severity. Similarly, limited associations between attachment and alcohol use have been shown in early to middle adolescence (Zhai et al., 2014; Eitle, 2005). This is likely due to the high prevalence of alcohol

use (at least initiation) in the current sample. Furthermore, the effects of attachment to parents on sons' regular alcohol use and alcohol use problems onset rate may not be statistically detectable until late adolescence and adulthood, when alcohol use escalates and greater differences in alcohol usage emerge. Taken together, the results from Cox regression further indicate that poor attachment to parents increase the risk for onset of illicit substance use and substance use problems.

The findings reported herein must be considered in the context of study limitations. Convergent validity of the YAPS was not tested due to the absence of another independent attachment scale. Nevertheless, the three component scales of the *YAPS* (*Communication*, *Alienation*, and *Trust*) align with items in other instruments measuring attachment, specifically the *PIML* (Cook et al., 1995; Ridenour, Greenberg et al., 2006) and the *IPPA* (Armsden & Greenberg, 1987). Furthermore, attachment was measured only from the child's perspective. Future research needs to elucidate the congruity between parents and children. Whether parental report of attachment is a superior predictor of substance use and SUD severity in the child also remains to be investigated. Attachment to other individuals such as siblings and non-parent relatives were not included in the analyses as this was beyond the scope of the study. Additionally, the sample included only male adolescents. Generalizability of findings may thus be limited. The association between attachment and adolescent substance use may also be biased due to the use of the high risk design. It is notable, however, that an association between poor attachment and SUD outcome was also demonstrated using community samples (Kostelecky, 2005; Essau, 2011). Lastly, only cannabis use was present in a sufficient number of subjects to obtain robust estimates in the Cox regression analyses. Hence, caution should be exercised in interpreting the association between attachment and age of onset of other illicit substances.

In summary, this is the first study to directly test the contribution of attachment relative parents' substance use severity and supervision on substance involvement in their offspring. The main findings are that attachment contributes to sons' substance involvement independent of parents' substance use severity and supervision; and attachment, beyond parental substance use severity, is also related to age of initiation and regular substance use, along with problems consequent to substance use in their sons. In effect, attachment to parents contributes unique variance on son's substance use beyond the presence of parental substance use.

**4.0 CHAPTER 4: ROLE OF ATTACHMENT IN THE ASSOCIATION BETWEEN
SUBSTANCE INVOLVEMENT IN PARENTS AND SONS**

4.1 INTRODUCTION

Deficits in parenting skills and maltreatment of children are frequent characteristics in parents with SUD. Emotional insensitivity and neglect of the child are, at least in part, attributed to the parents' substance use behavior. Indeed, parental substance use behaviors including drug seeking and taking as well as associated negative consequences of substance use behaviors, reduce opportunities for positive parent-child interactions and demonstrations of emotional sensitivity, availability, and security to the child. This chapter evaluates mediation and moderation models for understanding the role of attachment on the association between parents' and offspring's substance abuse.

The theoretical model of attachment as a mediator is depicted in Figure 1.1a. This model specifies that parents' SUD leads to SUD in their children indirectly through poor attachment quality. The theoretical model of attachment as a moderator is depicted in Figure 1.1b. In this model, attachment is theorized to augment the strength of association between parents' SUD and risk for SUD in children. While both models can be supported conceptually, the model which best informs the role of attachment in SUD etiology remains unknown. The primary purpose of this chapter is determining the model that most accurately explains the impact of attachment to parents on child's development of SUD. The secondary purpose of this chapter is to determine the association between *YAPS*, parental *SUSI*, and the risk for sons' illicit substance use in adolescence (age 16). The results of these analyses may inform the potential applications of attachment theory and methods to SUD prevention.

4.2 METHODS

4.2.1 Participants

The participants were 499 families in which the father had a biological son enrolled in a longitudinal investigation directed at elucidating the etiology of SUD, and a spouse who was the biological mother of the child willing to participate in the longitudinal study. Recruitment method and demographic characteristics are described in [Chapter 2](#).

4.2.2 Instrumentation

4.2.2.1 Substance Use Severity Index (SUSI): The *SUSI* (Kirisci, et al., 2002) documents severity of substance use in sons, fathers, mothers and overall parents. The formulation of the *SUSI* is described in [Chapter 2](#).

4.2.2.2 Substance Use Disorder Severity Index (SUDSI): The *SUDSI* (Kirisci et al., 2006) quantifies severity of SUD in sons taking into account the manifold permutations of co-occurring disorders. Formulation of the *SUDSI* is described in [Chapter 2](#).

4.2.2.3 Youth Attachment to Parents (YAPS): The *YAPS* (Zhai et al., 2014) measures the 10-12 year old son's emotional bonding and relationship with each biological parent. The method of development and psychometric properties of the *YAPS* are described in [Chapter 3](#).

4.2.2.4 Drug Use Chart: Items from the self-report *Drug Use Chart* (Center for Education and Drug Abuse Research, 1989) were selected to derive the *Illicit Substance Use* construct. The items capture use of: cannabis (marijuana), cocaine/crack, opiates (heroin, codeine, morphine, methadone, opium), amphetamines and methylphenidate (Ritalin), sedatives (barbiturates, Quaaludes, Seconal, Xanax, Librium, Valium, etc.), hallucinogens (LSD, mescaline, peyote, etc.), PCP, and inhalants (amyl nitrite, nitrous oxide, glue, gasoline, etc.). The items were combined to form a dichotomous variable to denote whether the boys at 16 years of age used an illicit substance. If the adolescent participant had ever tried any illicit drug, a score of 1 was assigned. Otherwise a score of 0 was assigned. The percentage of sons who used each type of illicit drug is shown in Table 4.1. A total of $n = 403$ sons returned for the age 16 assessment.

Table 4.1: Percentage of Adolescent (age 16) Illicit Substance Use in Sons

Substance	% of Sons ($n = 403$)
Amphetamine	2.7
Crack/Cocaine	1.7
Opiate	5.0
Sedative	1.0
Hallucinogen	5.0
PCP	0.7
Cannabis	34.2
Inhalant	2.7
Any Illicit Substance	35.7

4.2.3 Statistical Analyses

Pearson correlation was used to determine the association among *YAPS*, *SUSI*, and *SUDSI* scores of fathers, mothers, overall parents, and sons. Path analysis was conducted to elucidate the role of the *YAPS* in sons' *SUSI* using MPLUS (Muthen & Muthen, 1998-2011). Figure 4.1a depicts the base model of parental *SUSI* scores mediating the association between parental *SUDSI* and

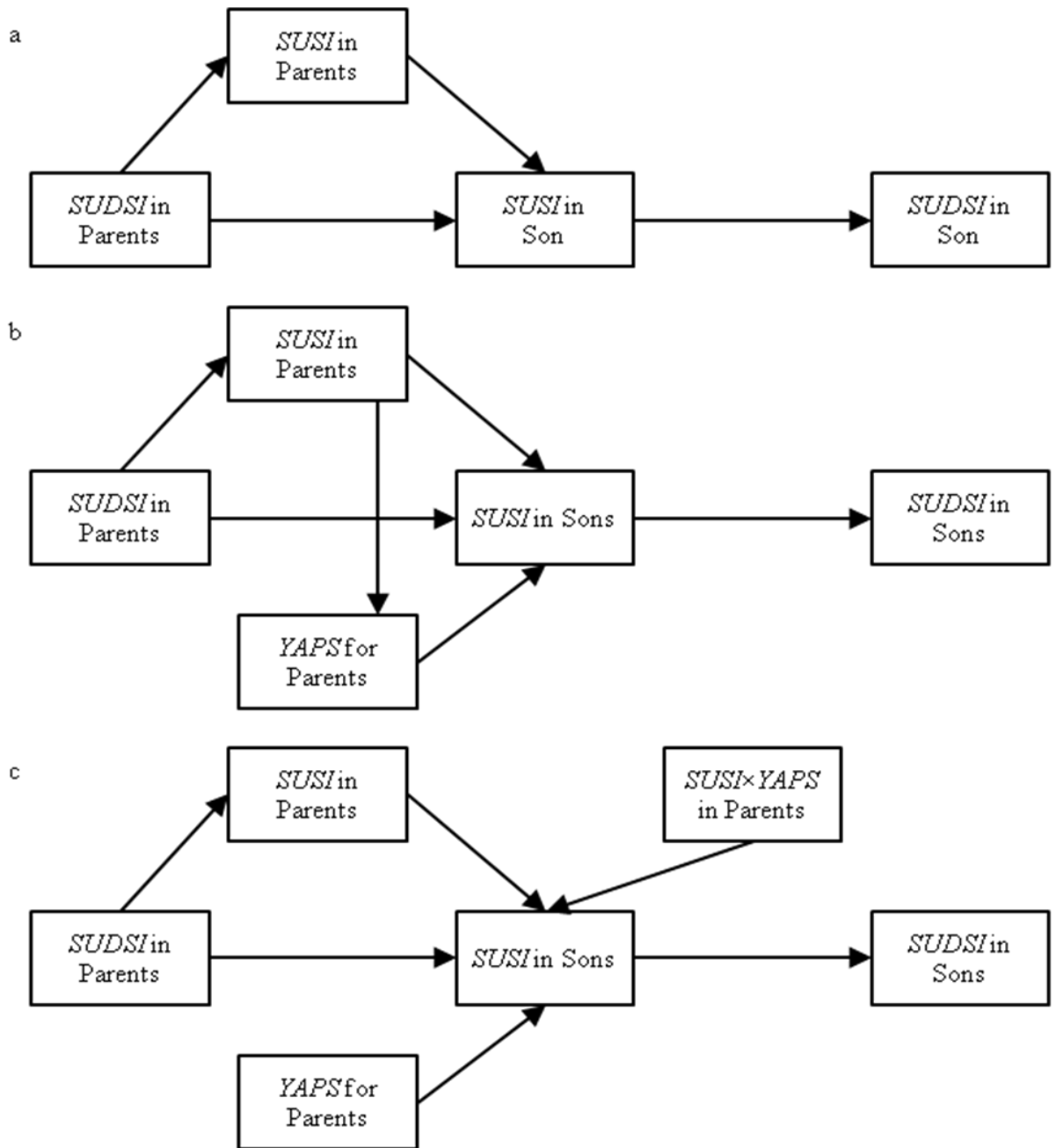


Figure 4.1: Test Models of YAPS in the Association between Parents' and Sons' SUSI. A. Base model of the association between parents' and sons' SUSI. B. Mediation by YAPS in the association between parents' and sons' SUSI. C. Moderation by YAPS in the association between parents' and sons' SUSI. *SUSI*×*YAPS* is the interaction term of parental *SUSI* and *YAPS*.

son's *SUSI* scores, leading to sons' *SUDSI* (see [Chapter 2](#), Figures [2.1.](#), [2.2.](#), and [2.3](#)). Figures 4.1b and 4.1c depict configuration of the test models in which the *YAPS* respectively is a mediator and a moderator of the association between parental *SUSI* and sons' *SUSI* scores. The mediator model (Figure 4.1b) was constructed from the base model by adding indirect paths between parents' and sons' *SUSI* through the *YAPS*. The moderator model (Figure 4.1c) was constructed from the base model by adding direct paths from *YAPS* as well as $YAPS \times$ parental *SUSI* interaction term to sons' *SUSI*. χ^2 goodness of fit, RMSEA, CFI, and TLI were used to determine model fit.

The hypothesis that attachment to parents mediated the relationship between substance use severity in parents and in sons was tested using Sobel's (1982) formula and the method described by Baron and Kenny (1986) with the following parameters: 1) The independent variable, *SUSI* in parents, predicts the dependent variable, *SUSI* in sons; 2) *SUSI* in parents predicts the mediator, *YAPS*; 3) *YAPS* predicts *SUSI* in sons. Full mediation is confirmed if the *YAPS* reduces the association between parents' *SUSI* and sons' *SUSI* to non-significance whereas partial mediation is present if the magnitude of association is reduced but remains significant. To test the hypothesis that attachment to parents moderates the relationship between substance use severity in parents and in sons, *YAPS* scores and a $YAPS \times$ parental *SUSI* interaction term were included as separate independent variables in the base model to directly load onto *SUSI* scores in sons. The *YAPS* scores were converted to z-scores for analysis of the moderation models. The $YAPS \times$ parental *SUSI* interaction terms were computed by multiplying *YAPS* and *SUSI* scores related to fathers, mothers, and overall parents, separately. *YAPS* was considered to have a significant moderation effect when the path between the $YAPS \times$ parental *SUSI* interaction term and sons' *SUSI* reached $p \leq .05$. Analyses were conducted separately for father-son, mother-son,

and overall parents-sons relationships. To account for possible issues of collinearity between parental *SUSI* and *SUDSI*, parental *SUDSI* was removed from the mediation and moderation models shown in Figures 4.2 to 4.7, and tested again.

Additionally, Pearson and bi-serial correlations were conducted to systematically determine the correlations between *YAPS* and parental *SUSI* scores, and illicit substance use in adolescent sons. Logistic regression was conducted using *YAPS* and parental *SUSI* scores as the independent variable in separate analyses and sons' illicit substance use at age 16 as the dependent variable.

4.3 RESULTS

4.3.1 Attachment to Parents: Mediation Model

The correlation analyses between *YAPS*, *SUSI*, and *SUDSI* scores are shown in Table 4.2. *YAPS* scores were significantly correlated with *SUSI* and *SUDSI* scores for fathers and overall parents. However, a significant correlation was not found for mothers.

Figure 4.2 shows the results of testing the mediation model of the role of *YAPS* for mothers in the relationship between mothers' and sons' *SUSI*. Good model-data fit was obtained ($\chi^2 = 7.43$, $df = 4$, $p = .12$, $RMSEA = .06$, $CFI = .98$, $TLI = .95$). *YAPS* in mothers did not show a significant mediation effect on the association between mothers' *SUSI* and sons' *SUSI* ($\beta = .01$, $z = .46$, $p = .65$). As observed in Figure 4.2: 1) higher *SUSI* in mothers predicted higher *SUSI* in sons; 2) *SUSI* in mothers was not associated with *YAPS* for mothers; and 3) lower *YAPS* for mothers predicted higher *SUSI* in sons. The association between mothers' *SUSI* and sons' *SUSI*

Table 4.2: Correlation between Family *YAPS*, *SUSI*, and *SUDSI*

	1	2	3	4	5	6	7	8	9	10
1. <i>YAPS</i> for Fathers										
2. <i>YAPS</i> for Mothers	.79***									
3. <i>YAPS</i> for Overall Parents	.95***	.94***								
4. Fathers' <i>SUSI</i>	-.10*	-.09*	-.10*							
5. Mothers' <i>SUSI</i>	.06	-.06	-.07	.50***						
6. Overall Parental <i>SUSI</i>	-.10*	-.09*	-.10*	.90***	.83***					
7. Sons' <i>SUSI</i>	-.19**	-.18**	-.21***	.18***	.27***	.27***				
8. Fathers' <i>SUDSI</i>	-.11*	-.09*	-.10*	.75***	.41***	.70***	.11*			
9. Mothers' <i>SUDSI</i>	-.07	-.04	-.06	.34***	.59***	.52***	.21***	.36***		
10. Overall Parental <i>SUDSI</i>	-.12*	-.09*	-.10*	.70***	.59***	.75***	.19***	.89***	.75***	
11. Sons' <i>SUDSI</i>	-.14**	-.14**	-.15**	.15***	.24***	.18***	.62***	.13**	.15***	.17***

*p ≤ .05, **p ≤ .01, ***p ≤ .001

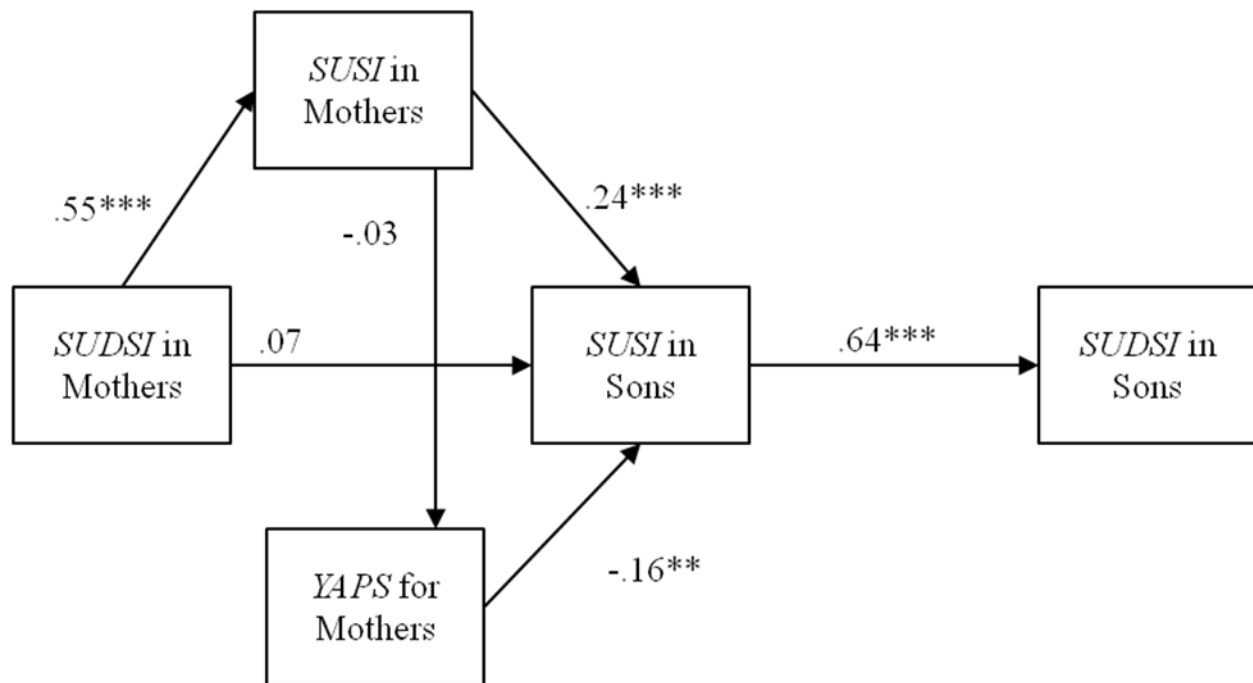


Figure 4.2: Mediation Effect of *YAPS* for Mothers in the Association between Mothers' and Sons' *SUSI* Scores. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

([Figure 2.1b](#): $b = .23$, $p < .001$) did not reduce to non-significance upon adding the *YAPS* for mothers as a mediator ($b = .24$, $p < .001$) to the base model shown in [Figure 2.1b](#) and 4.1a. Furthermore, sons' *SUSI* was significantly associated with sons' *SUDSI* with the inclusion of *YAPS* for mothers in the model. When mothers' *SUDSI* was removed from model shown in Figure 4.2. adequate model-data fit was obtained ($\chi^2 = 4.9$, $df = 2$, $p = .09$, $RMSEA = .07$, $CFI = .97$, $TLI = .92$). However, *YAPS* in mothers still did not show a significant mediation effect on the association between mothers' *SUSI* and sons' *SUSI* ($\beta = .01$, $z = .46$, $p = .65$). Hence, *YAPS* for mothers did not mediate the association between mothers' *SUSI* and sons' *SUSI*, which increased sons' *SUDSI*.

Figure 4.3 shows the mediation model evaluating the role of *YAPS* for fathers in the relationship between fathers' and sons' *SUSI*. Excellent model-data fit was obtained ($\chi^2 = 2.92$, $df = 4$, $p = .57$, $RMSEA = .001$, $CFI = .99$, $TLI = .99$). *YAPS* in fathers showed a significant mediation effect on the association between fathers' *SUSI* and sons' *SUSI* ($\beta = .02$, $z = 1.94$, $p = .05$). As seen in Figure 4.3: 1) higher *SUSI* in fathers predicted higher *SUSI* in sons; 2) higher *SUSI* in fathers was associated with lower *YAPS* for fathers; and 3) higher *YAPS* for fathers predicted lower *SUSI* in sons. The association between fathers' *SUSI* and sons' *SUSI* ([Figure 2.2b](#): $b = .25$, $p = .004$) did not reduce to non-significance upon adding the *YAPS* for fathers as a mediator ($b = .24$, $p = .02$) to the base model shown in [Figure 2.2b](#) and 4.1a, signifying a partial mediation. Furthermore, sons' *SUSI* was significantly associated with sons' *SUDSI* with the inclusion of *YAPS* for fathers in the model. Good model-data fit was obtained after fathers' *SUDSI* was removed from the model shown in Figure 4.3 ($\chi^2 = 2.24$, $df = 2$, $p = .33$, $RMSEA = .02$, $CFI = .99$, $TLI = .99$). *YAPS* for fathers still showed a significant mediation effect on the

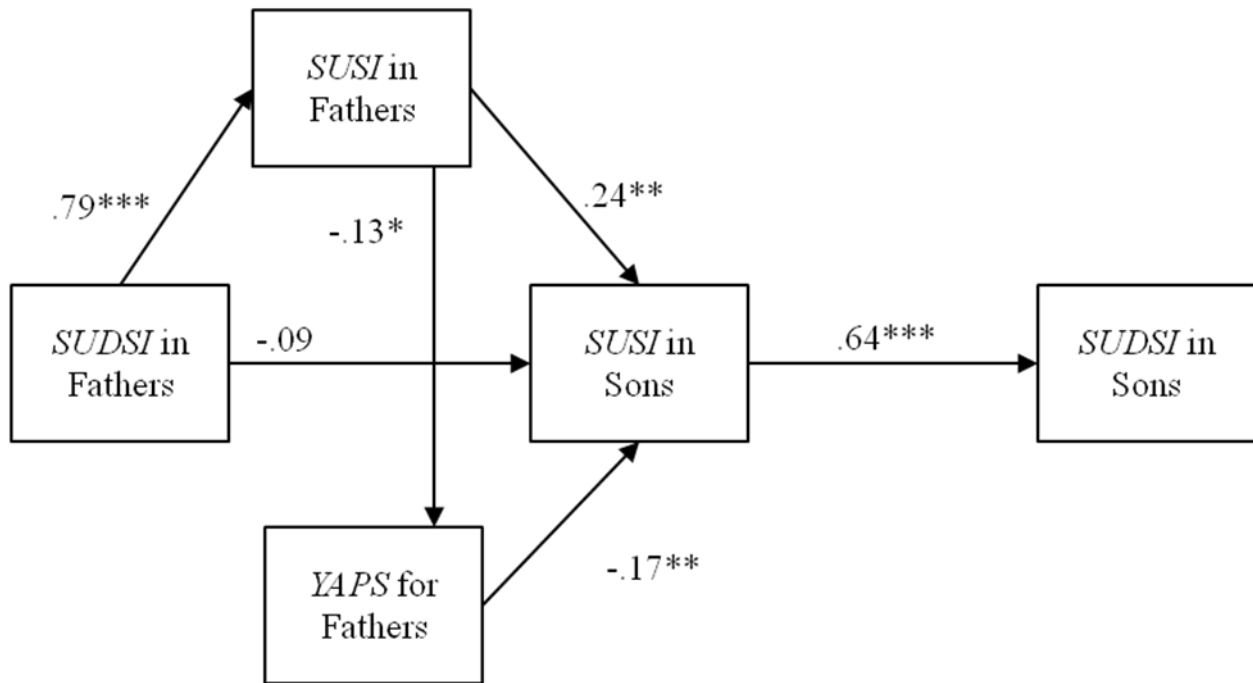


Figure 4.3: Mediation Effect of YAPS for Fathers in the Association between Fathers' and Sons' SUSI Scores. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

association between fathers' *SUSI* and sons' *SUSI* ($\beta = .02$, $z = 1.92$, $p = .05$). Hence, *YAPS* for fathers partially mediated the association between fathers' *SUSI* and sons' *SUSI* which, in turn, increased sons' *SUDSI*.

Figure 4.4 shows the results of testing the mediation role of *YAPS* for overall parents in the relationship between overall parents' and sons' *SUSI*. Good model-data fit was obtained ($\chi^2 = 5.45$, $df = 4$, $p = .25$, $RMSEA = .04$, $CFI = .99$, $TLI = .99$). Overall parental *YAPS* did not show a significant mediation effect on the association between overall parental *SUSI* and sons' *SUSI* ($\beta = .02$, $z = 1.53$, $p = .13$). Figure 4.4 shows that: 1) higher overall parental *SUSI* predicted higher *SUSI* in sons; 2) overall parental *SUSI* was not significantly associated with *YAPS* for overall parents; and 3) higher overall parental *YAPS* predicted lower *SUSI* in sons. The association between overall parental *SUSI* and sons' *SUSI* (Figure 2.3b: $b = .30$, $p < .001$) was not reduced to non-significance upon adding the overall parental *YAPS* as a mediator ($b = .29$, $p = .001$) to the base model shown in Figure 2.3b and 4.1a. Furthermore, sons' *SUSI* was significantly associated with sons' *SUDSI* with the inclusion of overall parental *YAPS* in the model. Good model-data fit was obtained after overall parental *SUDSI* was removed from model shown in Figure 4.4 ($\chi^2 = 2.92$, $df = 2$, $p = .23$, $RMSEA = .04$, $CFI = .99$, $TLI = .98$). However, *YAPS* in overall parents still did not show a significant mediation effect on the association between overall parental *SUSI* and sons' *SUSI* ($\beta = .02$, $z = 1.5$, $p = .13$). Hence, overall parental *SUSI* did not mediate the association between overall parental *SUSI* and sons' *SUSI*, which increased sons' *SUDSI*.

In summary, only *YAPS* for fathers mediates the association between fathers' *SUSI* and sons' *SUSI*. The model-data fit indices were in the good to excellent range.

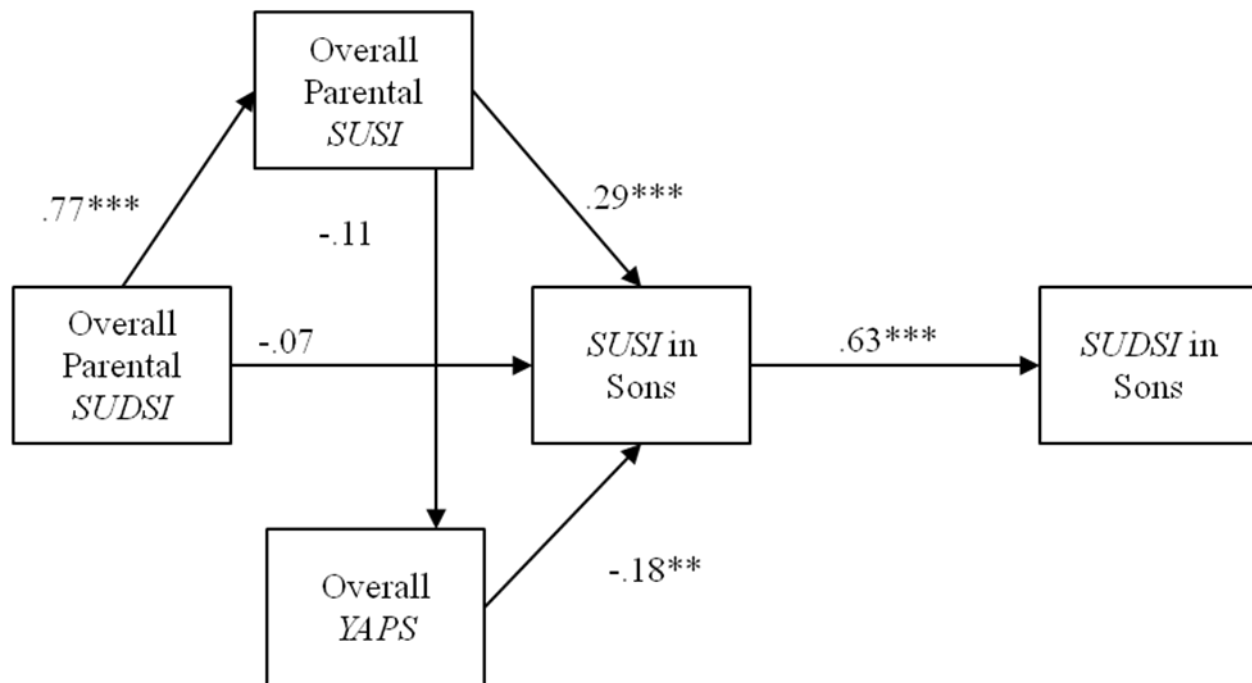


Figure 4.4: Mediation Effect of Overall *YAPS* in the Association between Overall Parental *SUSI* Scores and Sons' *SUSI* Scores. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

4.3.2 Attachment to Parents: Moderation Model

Figure 4.5 shows the results of evaluating the role of *YAPS* for mothers as a moderator of the relationship between mothers' and sons' *SUSI*. Good model-data fit was obtained ($\chi^2 = 8.18$, $df = 6$, $p = .23$, $RMSEA = .04$, $CFI = .99$, $TLI = .98$) when *YAPS* for mothers was included as a moderator in the base model shown in [Figures 2.1b](#) and 4.1a. The *YAPS* for mothers showed a significant association with sons' *SUSI* ($b = -.17$, $p = .004$), but the *YAPS* \times *SUSI* interaction term for mothers did not ($b = .01$, $p = .82$). Adequate model-data fit was obtained after mothers' *SUSI* was removed from model shown in Figure 4.5 ($\chi^2 = 6.84$, $df = 3$, $p = .08$, $RMSEA = .07$, $CFI = .97$, $TLI = .94$). *YAPS* for mothers showed significant association with sons' *SUSI* ($b = -.17$, $p = .002$) but the *YAPS* \times *SUSI* interaction term for mothers did not ($b = .02$, $p = .74$). Hence the *YAPS* for mothers did not moderate the association between mothers' and sons' *SUSI*.

Figure 4.6 shows the results of evaluating the role of *YAPS* in fathers as a moderator of the relationship between fathers' and sons' *SUSI*. Good model-data fit was obtained ($\chi^2 = 6.36$, $df = 6$, $p = .38$, $RMSEA = .02$, $CFI = .99$, $TLI = .99$) when *YAPS* for fathers was included as a moderator in the base model shown in [Figures 2.2b](#) and 4.1a. The *YAPS* for fathers showed a significant association with sons' *SUSI* ($b = -.14$, $p = .04$), but the *YAPS* \times *SUSI* interaction term for fathers did not ($b = .11$, $p = .11$). Excellent model-data fit was obtained after fathers' *SUSI* was removed from the model shown in Figure 4.6 ($\chi^2 = 2.31$, $df = 3$, $p = .51$, $RMSEA = .001$, $CFI = .99$, $TLI = .99$). *YAPS* for fathers showed significant association with sons' *SUSI* ($b = -.14$, $p = .04$) but the *YAPS* \times *SUSI* interaction term for fathers did not ($b = .11$, $p = .10$). Hence the *YAPS* in fathers did not moderate the association between fathers' and sons' *SUSI*.

Figure 4.7 shows the results of evaluating the role of *YAPS* in overall parents as a moderator of the relationship between overall parents' and sons' *SUSI*. Excellent model-data fit

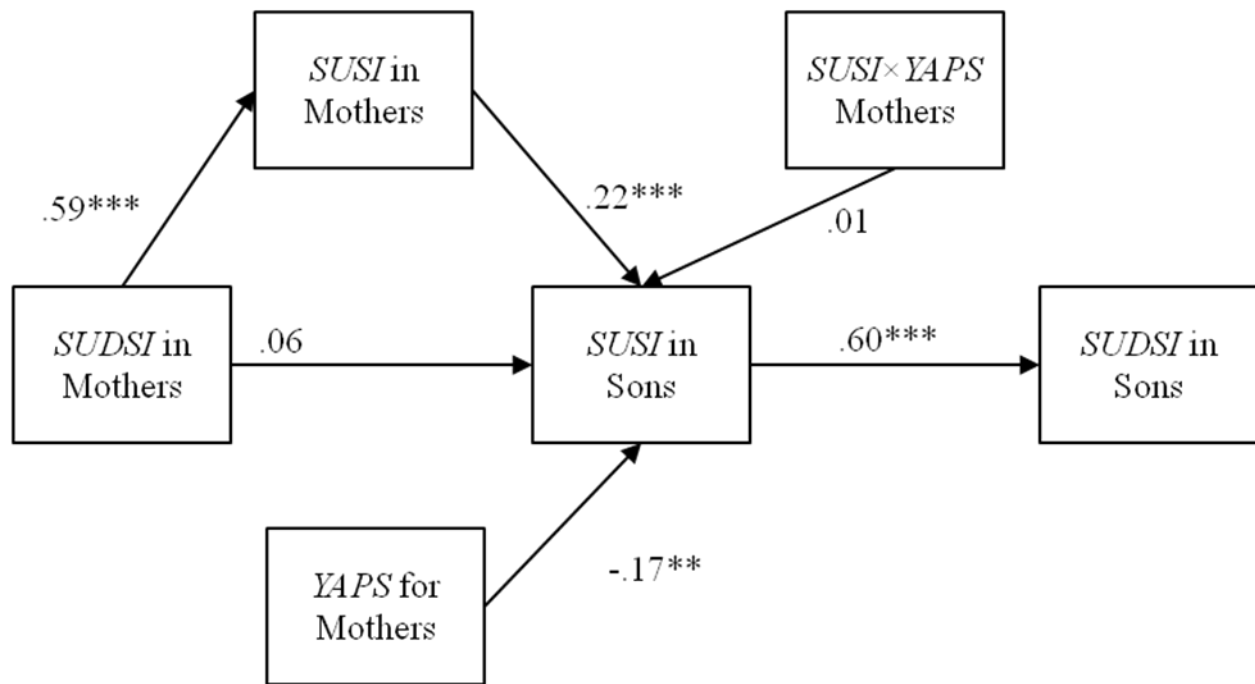


Figure 4.5: Moderation Effect of YAPS for Mothers in the Association between Mothers' and Sons' SUSI Scores. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

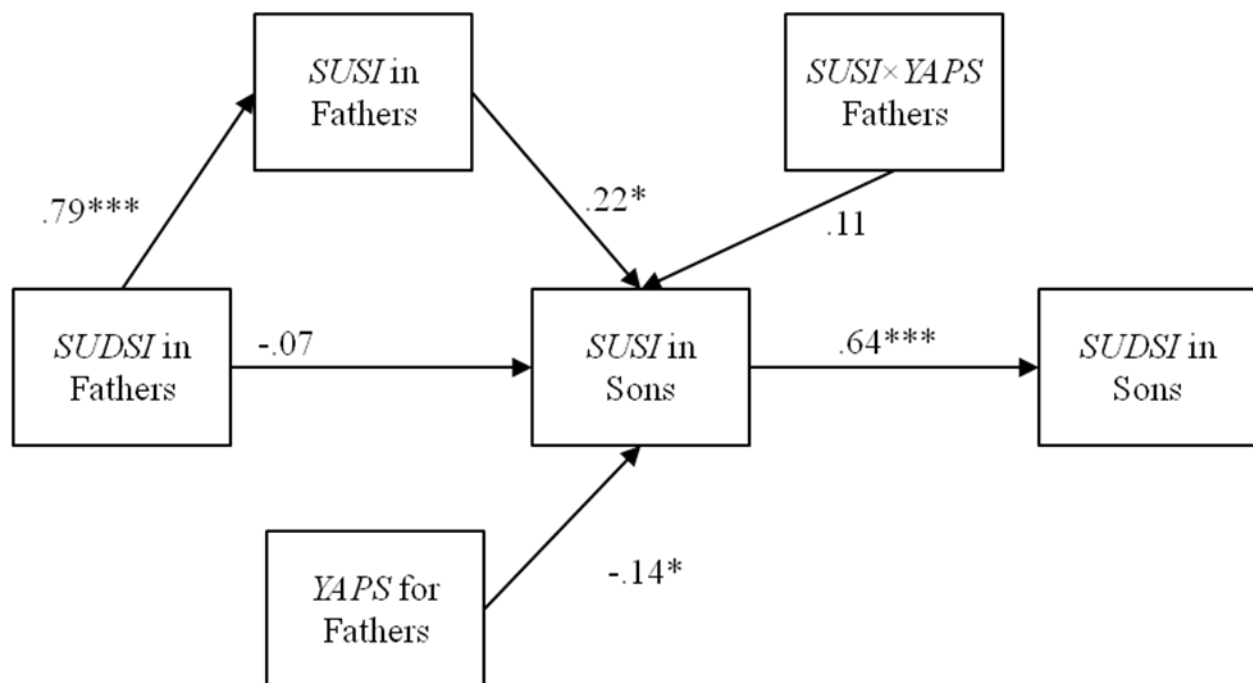


Figure 4.6: Moderation Effect of YAPS for Fathers in the Association Between Fathers' and Sons' SUSI Scores. $^*p \leq .05$, $^{**}p \leq .01$, $^{***}p \leq .001$

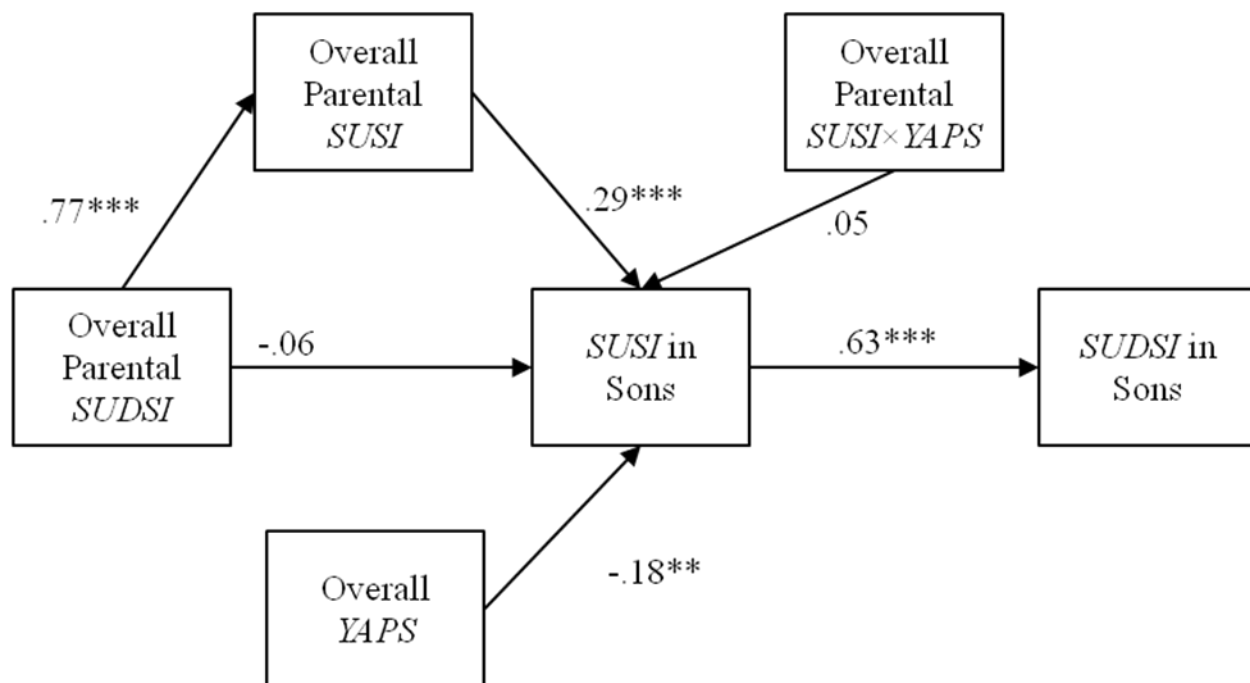


Figure 4.7: Moderation Effect of Overall *YAPS* in the Association between Overall Parental *SUSI* Scores and Sons' *SUSI* Scores. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

was obtained ($\chi^2 = 4.73$, $df = 6$, $p = .58$, $RMSEA < .001$, $CFI = .99$, $TLI = .99$) when *YAPS* for overall parents was included as a moderator in the base model shown in [Figures 2.3b](#) and 4.1a. For overall parents, the *YAPS* showed a significant association with sons' *SUSI* ($b = -.18$, $p = .01$), but the *YAPS* \times *SUSI* interaction term did not ($b = .05$, $p = .459$). Good model-data fit was obtained after overall parental *SUSI* was removed from model shown in Figure 4.7 ($\chi^2 = 3.38$, $df = 3$, $p = .34$, $RMSEA = .02$, $CFI = .99$, $TLI = .99$). The *YAPS* for overall parents showed a significant association with sons' *SUSI* ($b = -.17$, $p = .01$) but the *YAPS* \times *SUSI* interaction term for overall parents did not ($b = .06$, $p = .44$). Hence, the *YAPS* for overall parents did not moderate the association between overall parental *SUSI* and sons' *SUSI*.

In summary, *YAPS* did not moderate the association between parents' *SUSI* and sons' *SUSI*. Furthermore, the moderation models showed good to excellent model-data fit

4.3.3 Association Between Parental *YAPS*, *SUSI* , and Adolescent Illicit Substance Use

The results of correlation analyses between *SUSI* and *YAPS* scores in parents and adolescent sons' illicit substance use are shown in Table 4.3. Parental *SUSI* scores and lower *YAPS* scores were positively correlated with illicit substance use in adolescent sons. Additionally, the results of logistic regression between parental *SUSI* scores and *YAPS* scores predicting adolescent sons' illicit substance use are shown in Table 4.4. Results from separate regression analysis indicate that parental *SUSI* scores and lower *YAPS* scores were positively associated with illicit substance use in adolescent sons. Hence, *YAPS* and parent's *SUSI* predicted adolescent sons' illicit substance use.

Table 4.3: Correlation between Parental *SUSI*, *YAPS*, and Sons' Adolescent Illicit Substance Use

Sons' Adolescent Illicit Substance Use	
<i>YAPS</i>	
Fathers	-.14**
Mothers	-.16***
Overall Parents	-.16**
<i>SUSI</i>	
Fathers	.18***
Mothers	.27***
Overall Parents	.26***
*p ≤ .05, **p ≤ .01, ***p ≤ .001	

Table 4.4: Regression between Parental *SUSI*, *YAPS*, and Sons' Adolescent Illicit Substance Use

Sons' Adolescent Illicit Substance Use		
Predictors	Odds Ratio	95% CI
<i>YAPS</i>		
Fathers	.94*	.89-.99
Mothers	.92**	.86-.97
Overall Parents	.96**	.93-.99
<i>SUSI</i>		
Fathers	1.37**	1.09-1.73
Mothers	1.78***	1.39-2.27
Overall Parents	1.35***	1.17-1.56
*p ≤ .05, **p ≤ .01, ***p ≤ .001		

4.4 DISCUSSION

To briefly recapitulate, *YAPS* for fathers showed significant mediation effects on the relationship between fathers' and sons' *SUSI*. However, *YAPS* for fathers, mothers, and overall parents did not show significant moderation effects. Similar results were found after removing parental *SUDSI* from the mediation and moderation models. Additionally, *YAPS* and *SUSI* in parents were associated with illicit substance use in 16 year old sons.

Within the normatively socialized population, attachment between parent and child lead to the child's internalization of traditional norms and reduces risk of antisocial and norms-violating behavior which, in turn, increases associations with non-substance-using peers and substance desistance (Bandura, 1977; Kosterman, Hawkins, Guo, Catalano, & Abbott, 2000; Dogan et al., 2007; Brook, Brook, Gordon, Whiteman, & Cohen, 1990). The results of this study indicate that poor attachment to fathers mediate, at least partially, the relationship between substance use severity in fathers' and sons'. Parental substance use detracts from parenting thereby impeding attachment that predisposes to child problem behaviors (Conger & Simons, 1997; Laub & Sampson, 1988; Patterson & Capaldi, 1991; Smith & Stern, 1997). To illustrate, numerous factors stemming from parental substance use may contribute to dysfunctional parenting to hamper parent-child bonding, including time away from their children while procuring and using substances and the legal consequences such as jail time. These factors reduce parenting opportunities and impede secure protection of the child. Additionally, violence and agitation, consequent to drug use induce disinhibition and withdrawal (Ammerman et al., 1999) so as to further reduce child's feelings of security required for attachment. Elevations in substance use and SUD risk have been shown to be antecedents of poor attachment relationships (Caspers, Yucuis, Troutman, & Spinks, 2006; Brook et al., 2013; Zhai et al., 2014). Hence the

contribution of parental SUD to offspring's' SUD risk involves the detrimental effect of parental substance use on parent-child attachment quality that, in turn, increases the severity of substance use in children.

The role of attachment to parents in their child's risk for SUD is consistent with the well studied relationship between stress and anxiety and the development of SUD (Ruglass, Lopez-Castro, Cheref, Papini, & Hien, 2014). Stress and anxiety, via multiple mechanisms (Ruglass et al., 2014) amplify SUD risk (Grant et al., 2004; Kessler, Chiu, Demler, Merikangas, & Walters, 2005). Child maltreatment and inept parenting consequent to parental substance abuse (Magura & Laudet, 1996; Bailey et al., 2013), hampers child's feelings of security and manifests as heightened anxiety (Mikulincer & Shaver, 2007; Nolte et al., 2011). Additionally, youths who experience deficient caregiving from parents exhibit elevated stress responses and difficulty regulating anxiety (Gunnar & Quevedo, 2007, 2008; Main & Solomon, 1986, Main & Hesse, 1990). Accordingly, strong attachment relationships to parents enhances child's feelings of security and harm protection (Bowlby, 1973) by promoting regulation of stress and anxiety (Mikulincer & Shaver, 2007; Sbarra & Hazan, 2008; Nolte et al., 2011; Ditzen et al., 2008). As such, poor parent-child attachment quality forecasts greater risk for anxiety disorders (Manassis, Bradley, Goldber, Hood, & Swinson, 1994; Warren et al., 1997). In sum, attachment to parents may mediate the relationship between parents' and sons' substance use by regulating the stress and anxiety induced by deficient parenting.

Attachment to fathers only partially mediated the relationship between fathers' and sons' substance use severity. This was expected as fathers' substance use has direct effects on offspring's risk for substance use, and indirect effects through multiple pathways that may not involve attachment. The partial mediation is also consistent with the multiple regression analyses

from [Chapter 3](#) indicating that both attachment to fathers and fathers' substance use severity independently increased sons' substance use and SUD severity. While the mediation effect of attachment to fathers is significant, it explains only a portion of the overall contribution of fathers' substance use on sons' substance involvement. Furthermore, there was no correlation between attachment to mothers and substance use severity in mothers, indicating that one of the criteria for statistical mediation was not satisfied. This finding precludes the mediation effect of attachment to mothers on the association between mothers' and sons' substance use severity, which was verified by model testing ([Figure 4.2](#)). These results were not likely due to confounding effects of testing parental *SUSI* and *SUDSI* together because similar results were found even after removing parental *SUDSI* from the models. The lack of association necessary for statistical mediation may largely be due to the relatively low percentage of mothers with substance use and SUD related to several drug classes. SUD in mothers was not a recruitment criterion since the probands were the fathers. Accordingly, the rate of substance use and SUD diagnosis in the mothers is lower than the fathers. The smaller sample of substance using mothers may have considerably limited the capacity of detecting an association between mother's substance use severity and attachment to mothers. Alternatively, children's attachment and bonding with their mothers may not be impacted by their mother's substance use to the same extent as their fathers. Further studies are necessary to directly compare magnitude of deleterious effects of parental substance involvement on attachment quality in mothers and fathers.

Attachment to parents also did not show moderation of the relationship between parental substance use severity and sons' substance use severity. Previous studies have posited that behaviors related to substance use and perceptions of substance use (positive or negative) are learned through interactions with closely associated individuals, including parents (Bandura,

1977). Attachment to parents, reflecting emotional bonding with and availability of parents, potentially fits into this framework as a moderator. Specifically, levels of attachment reflect closeness and opportunities, or lack thereof, for children to interact with and acquire attitudes regarding drugs from parents, thereby altering the association between parents' and sons' substance use severity (Sutherland, Cressey, & Luckenbill, 1992). The results of the moderation analyses are not consistent with the hypothesized moderation framework as the effect of parental substance use severity and attachment interaction on sons' substance use severity did not reach significance. Attachment to fathers, mothers and overall parents, however, did show significant direct effects on sons' substance use severity in these models, consistent with multiple regression analysis results in [Chapter 3](#). Taken together, the results support a mediation rather than moderation model of attachment to parents to account for the relationship between parental and sons' substance use severity. However, as the results show, mediation is partial and limited to fathers.

Data from the National Comorbidity Survey indicate that the estimated peaks of alcohol and marijuana use occur at age 18, while the peak of cocaine use occur at age 22 (Wagner & Anthony, 2002). The negative association between attachment and illicit substance use at age 16 suggests that poor parent-child bonding contributes to adolescent substance use. Other studies have also observed that prosocial family processes including monitoring and attachment are negatively associated with substance use initiation at a young age (Oxford et al., 2001). The association may arise via early disengagement from parental influences in favor of peer affiliations in children with poor attachment to parents (Oxford et al., 2001). This is of particular importance as early substance use is related to a variety of negative outcomes including greater risks of substance abuse or misuse problems during later adolescence and early adulthood

(Anthony & Petronis, 1995; Hawkins et al., 1997; Warner & White, 2003) as well as other health risks (DuRant, Smith, Kreiter, & Krowchuk, 1999). Early initiation of alcohol use increases risk for alcohol abuse and dependence later in development (Chou & Pickering, 1992). Furthermore, neurophysiological systems are particularly sensitive to disruption by abusable substances during this early developmental period (Spear, 2000). Hence, attachment to parents may have utility for indicating risk for early substance use well in advance. Receiver operator curve analysis is necessary to demonstrate the informativeness of attachment to parents for identifying youths at high risk for substance use.

The findings reported herein must be considered in the context of study limitations. The absence of mediation by attachment to mothers in the association between mothers' and sons' substance use severity may be due to the limited variance in mothers' substance use and SUD severity. The percentages of mothers' substance use and SUD related to several drug classes were relatively low. In addition, there were a limited number of sons' who exhibited illicit substance use at age 16. As the differences between the effects of attachment to fathers and attachment to mothers were not a central focus of the current study, direct comparisons were not made between the models related to each parent. As such, caution should be exercised in interpreting contrasts in the effects of attachment to each parent in offspring's SUD etiology.

This study supports the heuristic potential for utilizing attachment indicators in prevention strategies for children at high risk for SUD. Parent-child attachment is a critical component in the contribution of parents' SUD to their children's substance involvement. By demonstrating that attachment uniquely predicts children's SUD risk, and mediates the relationship between parents' and sons' substance use, this study identifies a potential node for interventions in high-risk youth. Interventions that focus on bolstering attachment may attenuate

children's risk for SUD. Additionally, advanced detection of risk is of major importance to prevention. Attachment, featured with emergence in early development and the ability to predict risk for adolescent substance involvement, may be a particularly useful tool in prevention strategies. Attachment scales may be applied to assess and identify high-risk individuals for interventions at earlier ages before substance use onset and consequent neuropsychological impairments.

5.0 CHAPTER 5: CONCLUSIONS AND FUTURE DIRECTIONS

5.1 SUMMARY OF RESEARCH GOALS

The overarching goals of this longitudinal research were to determine the contribution of parent-child attachment quality on the child's development of SUD within the context of parental substance use and SUD, and derive a model that best explains the role of attachment on the development of SUD. The first objective, addressed in [Chapter 2](#), was to determine which among the multitude of aspects of substance involvement in parents was most critical in the pathway between parental SUD and sons' substance involvement. A supporting objective was to determine the effect of parental supervision on sons' substance involvement. Additionally, Chapter 2 aimed to develop a model explaining the function of the most critical aspects of parental substance involvement in the relationship between parental SUD and sons' substance involvement. This research formed the base model from which the role of attachment on the association between parents' and sons' substance involvement was tested.

The second objective, addressed in [Chapter 3](#), was to evaluate the independent influence of attachment to parents on sons' SUD beyond the effect of parent's substance involvement and parental supervision. A supporting objective was to determine the influence of parental supervision, relative to parent's substance involvement, on sons' SUD. To further accomplish the second objective, an additional component aimed to evaluate the independent effect of attachment to parents while controlling for parental substance use on the rate of sons' substance use initiation, regular use, and problems with use. The third objective, addressed in [Chapter 4](#), was to develop a model explaining the effects of attachment to parents on the relationship between parents' and sons' substance involvement. A supporting objective was to demonstrate the ability of attachment to predict adolescent illicit substance use.

5.2 KEY FINDINGS

The first objective was achieved in [Chapter 2](#) by using linear regression analyses to determine the aspect of parental substance involvement that most highly and consistently predicted sons' substance involvement. Regression results revealed that, among the multitude of parental substance involvement parameters, parents' substance use severity was the best and most consistent predictor of sons' substance involvement. Additionally, the number of SUD parents and parental supervision predicted substance use and SUD severity in sons, though to a relatively lesser degree. Although theoretically relevant to the exposure of parental substance use to offspring, duration of regular (at least once per month) substance use in parents was not associated with sons' severity of substance use in the sample defined in the current study. A base model explaining the effects of parental substance use severity in the association between parents' SUD and sons' substance involvement was completed using structural equations modeling. In general, parental substance use severity mediated the relationship between parental SUD severity and sons' substance use severity which, in turn, contributed to sons' SUD severity. Hence, parent's disorder diagnosis increased the risk for sons' substance use via the parent's behavioral usage of substances.

The second objective was achieved in [Chapter 3](#) by using multiple regression to determine the extent that attachment, relative to parents' substance involvement and parental supervision, contributed to substance use and SUD in sons. Attachment to parents independently predicted sons' substance involvement after accounting for parental substance use severity, as well as after accounting for parental supervision. The additional component aimed to evaluate the effect of attachment to parents on substance initiation, first regular use, and first problems with use was accomplished using Cox regression. Attachment to parents was associated with

sons' onset rates of cannabis use initiation, regular cannabis use, and problems due to cannabis use even after controlling for parents' substance use severity.

The third objective was accomplished in [Chapter 4](#) by using structural equation modeling of the two competing mediation and moderation models of attachment to parents in the pathway between parents' and sons' substance involvement. Only attachment to fathers mediated the relationship between parent's and sons' substance use severity. No moderation effects were observed. The supporting objective was completed by using bi-serial correlation and logistic regression between attachment to parents and illicit substance use in sons at age 16. Attachment to parents correlated with and predicted the risk of illicit substance use in adolescent sons.

5.3 CLINICAL RELEVANCE

Whereas attachment mediates the association between parents' and children's substance use/SUD, it also independently predicts these children's outcomes beyond parents' use/SUD and supervision. These findings suggest that attachment quality may be an intervention node. Interventions focusing on attachment may thus improve prevention outcomes. Specifically, bolstering parent-child bonding may attenuate SUD risk in children with and without parental SUD.

Promoting attachment to parents may be important for substance use prevention. Attachment-based preventions have shown some success in mitigating substance use and SUD in high risk children, as well as improving child's mental and physical health, and well-being (Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2003; Egeland, Weinfield, Bosquet, & Cheng, 2000; van IJzendoorn, Juffer, & Duyvesteyn, 1995). Parental involvement, including

strong parent-child attachment, has been argued to lower children's risk of substance use (Brook, Whiteman, Gordon, & Cohen, 1986; Gorsuch & Butler, 1976; Jessor & Jessor, 1977; Kim, 1979; Norem-Hebeisen, Johnson, Anderson, & Johnson, 1984; Selnow, 1987). Additionally, parents who are unskilled in monitoring child's behavior and applying firm consistent discipline are more likely to use hostile and coercive methods which exacerbate antisocial tendencies (Patterson, 1982, Patterson & Stouthamer-Loeber, 1984; Reiss et al., 1995). Interventions directed at enhancing parenting skills that promote stronger parent-child attachment include methods such as instructing parents on monitoring their child's behavior, and directing parents to apply moderate consistent discipline against delinquent behavior as well as consistent reward for desired prosocial behavior. These adjustments to parenting skills reduce deficits in age appropriate skills and decrease maladaptive behavior problems in children (Hawkins et al., 1992; Patterson & Fleischman, 1979; Fleischman, 1981; Patterson & Reid, 1973; Peed, Roberts, & Forehand, 1977). Taken together, these findings suggest that training substance abusing parents to be more sensitive and responsive to their children's distress improves bonding which, in turn, may reduce later behavioral and social problems (Suchman et al., 2004).

However, caution must be exercised in making inferences about attachment-based intervention. The estimated effect sizes of attachment to parents on children's SUD risk is specific to the current study sample which may differ in other populations. Nevertheless, this study supports the heuristic potential of attachment based interventions in children at in high SUD risk. Parent-child attachment is an integral factor in SUD etiology. Accordingly, behavioral interventions that strengthen child's attachment to parents to enhance emotional security may reduce child's risk for substance use and SUD.

5.4 FUTURE DIRECTIONS

Attachment to parents during childhood has wide ranging consequences on other social relationships during the course of development. These consequences include selection of and engagement with peers as well as romantic partners. Affiliations with delinquent peers are strongly associated with risk for substance use and SUD. Hence, it is hypothesized that delinquent peer affiliation emanating from poor attachment to parents increase risk for and severity of substance involvement in youths. It is suggested from the present results that future research may examine the mediation and moderation effects of affiliations with deviant peers on the association between child's attachment to parents and substance involvement. It would also be informative to explore whether attachment to parents accounts for associations between antisocial characteristics in parents and their child's selected peers. Other maladaptive social outcomes consequent to attachment quality deserving further investigation include risky sexual behavior, multiple sexual partners, and unstable romantic bonding.

OXT /AVP neurohormones facilitate attachment to parents, and have been independently linked to substance use and SUD risk. However, the exact relationship between OXT/AVP expression, and SUD liability in parents and offspring remains unclear. Inasmuch as these neurohomormones contribute to attachment bond formation, OXT/AVP may be critical to the transmission of SUD from parents to offspring. Considering the findings in the present study, it is important for future research to explore the mediation and moderation effects of OXT/AVP expression in the pathway between parents' and offspring's SUD. Recent findings indicate an association between the *AVPR1A* gene single nucleotide polymorphism rs11174811 (linked to an microRNA binding site disruption) and drug use disorder that is mediated by spousal satisfaction (Maher et al., 2011). Additional studies may examine the effect of attachment to parents

consequent to offspring's OXT/AVP levels on the risk for substance use and SUD. It can be hypothesized that deficiencies in OXT/AVP levels, via their effect on the quality of attachment in offspring, may increase the risk of SUD. Furthermore, an abundance of studies have focused on the effects of OXT/AVP through experimental treatment paradigms such as intranasal OXT or AVP infusion. Utilizing measurements of endogenous peptide levels in the cerebrospinal fluid in modeling the etiological pathways of SUD provide a clearer understanding of OXT and AVP functionality in emotional bonding and substance use behavior.

Lastly, secure attachment to parents is critical to stress regulation, especially during early child development, and modulate the risk for psychopathology and anxiety disorders. Prevention studies have examined the efficacy of attachment-based approaches such as training individuals to improve parenting skills. Future work may test the efficacy of combining training in parenting skills to improve bonding and teaching stress management skills on children's risk for SUD. Combined enhancement of attachment bonding and stress regulation may improve security and protection that is critical to forming the "secure base" from which youths can optimally develop neurocognitive and affect regulatory competence. Additional research may also explore the effects of the combined parenting and stress management skills training on intermediate variables that precede SUD, including executive cognitive functioning, aggression, and emotional regulation.

APPENDIX

FACTOR STRUCTURE OF THE YOUTH ATTACHMENT TO PARENTS SCALE

Factor Matrix 1 st Order Factors	Loadings					
	Father			Mother		
	C	A	T	C	A	T
<i>C1. Can you discuss your beliefs with your father/mother without feeling afraid</i>	.58	.09	.14	.59	.04	.16
<i>C2. Is your father/mother a good listener</i>	.47	.21	.20	.57	.23	.09
<i>C3. Are you very satisfied with how your father/mother and you talk together</i>	.53	.21	.17	.57	.15	.11
<i>C4. If you were in trouble, could you tell your father/mother</i>	.59	.11	.17	.59	.12	.16
<i>C5. Do you openly show your father/mother that you like him</i>	.46	.22	.16	.50	.15	.17
<i>C6. Does your father/mother try to understand what you think</i>	.53	.20	.10	.52	.20	.08
<i>C7. Do you think you can tell your father/mother how you feel about things</i>	.34	.05	.15	.40	.11	.10
<i>C8. Do you tell your father/mother about your person problems</i>	.56	.17	.18	.59	.12	.24
<i>C9. Do you keep your feelings to yourself rather than tell your father/mother</i>	.39	.10	.18	.45	.10	.15
<i>C10. If you get upset, does your father/mother try to find out what is the matter</i>	.43	.21	.13	.39	.15	.10
<i>C11. Does your father/mother encourage you to think about things yourself</i>	.47	.20	.06	.39	.15	.07
<i>C12. Can you let your father/mother know what is bothering you</i>	.67	.12	.17	.68	.08	.14
<i>C13. If you do something wrong, does your parent need to listen to your side</i>	.50	.26	.17	.47	.23	.20
<i>C14. Does your father/mother make you feel free to say what you think</i>	.49	.14	.21	.50	.13	.18
<i>C15. How often have you thought your father/mother was really good</i>	.34	.18	.19	.38	.15	.12
<i>C16. How often does your parent find time to listen to you when you want</i>	.44	.23	.18	.46	.15	.19
<i>A1. My father/mother makes me feel better after I talk over my worries</i>	.37	.44	.23	.32	.41	.21
<i>A2. My father/mother understands my problems and my worries</i>	.35	.55	.20	.34	.54	.14
<i>A3. My father/mother gives me a lot of care and attention</i>	.32	.60	.23	.24	.58	.13
<i>A4. My father/mother seems proud of the things I do</i>	.18	.59	.16	.15	.58	.11
<i>A5. My father/mother isn't interested in changing me, but likes me as I am</i>	.13	.42	.20	.09	.45	.14
<i>A6. I like to talk to and be with my father/mother much of the time</i>	.24	.56	.20	.20	.49	.18
<i>T1. When I'm upset, my father/mother usually knows why</i>	.25	.21	.43	.23	.10	.39
<i>T2. When I'm upset, I know my father/mother really cares</i>	.17	.13	.68	.08	.06	.62
<i>T3. When I have a problem, my father/mother helps me solve it</i>	.19	.13	.63	.10	.01	.65
<i>T4. My father/mother is available when I want to talk to him/her</i>	.23	.20	.51	.16	.08	.54
<i>T5. My father/mother expects too much of me</i>	.21	.18	.43	.18	.18	.40

Appendix Continued

<i>T6. Even if my father/mother disagrees, he still listen to my point of view</i>	.20	.22	.50	.20	.21	.47
<i>T7. My father/mother really trusts me</i>	.15	.11	.69	.14	.14	.51
<i>T8. I can count on my father/mother to help me in a crisis</i>	.15	.14	.69	.16	.16	.63
<i>T9. We don't really trust each other</i>	.11	.10	.42	.12	.15	.44
2nd Order Factor	Attachment		Attachment			
<i>Communication</i>	.79		.77			
<i>Alienation</i>	.78		.68			
<i>Trust</i>	.68		.61			

Bold values indicate largest loadings onto each factor. Factor items summed for 2nd order factor analysis. C = Communication, A = Alienation, T = Trust. Cronbach's alpha: fathers = .91, mothers = .90.

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